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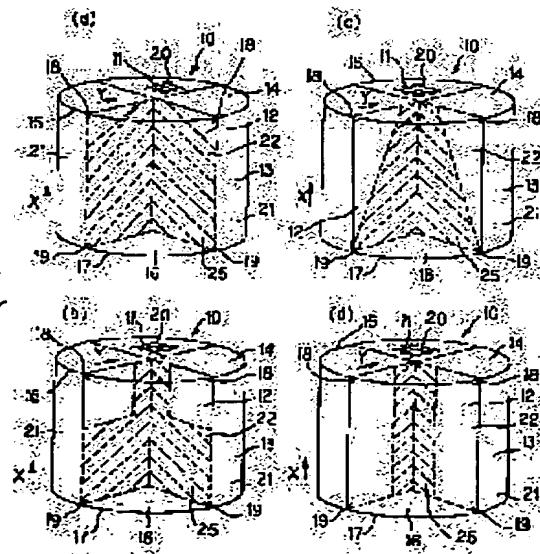
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## (54) HONEYCOMB CONSTRUCTION BODY, HONEYCOMB FILTER AND THEIR MANUFACTURING METHOD

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a honeycomb construction body which is excellent in durability and does not cause the occurrence of crack due to thermal stress in using, and their manufacturing method.

**SOLUTION:** The honeycomb structure body is provided with a plurality of honeycomb members 21 having many ventilation holes 11 partitioned by partitions 20. These honeycomb members 21 are joined by surfaces (joining surfaces) 22 being substantially parallel to the passage direction of the ventilation holes to be integrated to form the honeycomb structure body. The surface 22 at the member 21 includes an end part to be connected with a passage entrance end face outer peripheral part 15 and/or a passage exit end face outer peripheral part 17 and has an un-joined part 12 in the structure.



### LEGAL STATUS

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**CLAIMS**

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**[Claim(s)]**

[Claim 1] Two or more preparations and these two or more honeycomb members substantially the honeycomb member which has the negotiation hole of a large number divided by the septum with this honeycomb member by the joint material of this construction material It is the honeycomb structure object with which it is substantially joined to the direction of passage of this negotiation hole in respect of being parallel, and comes to unify these two or more honeycomb members. The honeycomb structure object with which the plane of composition in this honeycomb member is characterized by having the unsealed section at least including the edge linked to the passage inlet-port end-face periphery section and/or the passage outlet end-face periphery section.

[Claim 2] It has two or more honeycomb members which have the negotiation hole of a large number divided by the septum. It is the honeycomb structure object which joins these two or more honeycomb members to the direction of passage of this negotiation hole by joint material in respect of being parallel substantially, and it comes to unify. Si content as which this honeycomb member uses Metals Si and SiC as a principal component, and is specified by Si/(Si+SiC) is 5 - 50 % of the weight. Si content as which this joint material uses Metals Si and SiC as a principal component, and is specified by Si/(Si+SiC) The honeycomb structure object with which equivalent [ to this honeycomb member joined ], and it is 10 - 80 % of the weight than it, and the plane of composition in this honeycomb member is characterized by having the unsealed section at least including the edge linked to the passage inlet-port end-face periphery section and/or the passage outlet end-face periphery section.

[Claim 3] The honeycomb structure object according to claim 1 or 2 with which this joint material is characterized by being continuously arranged in this plane of composition.

[Claim 4] A honeycomb structure object given in any 1 term of claims 1-3 characterized by preparing this unsealed section of this plane of composition in the direction of passage of this negotiation hole by 10% or more of die length to the overall length of this honeycomb structure object in this direction from this passage inlet-port end-face periphery section or the passage outlet end-face periphery section.

[Claim 5] A honeycomb structure object given in any 1 term of claims 1-4 characterized by preparing this unsealed section of this plane of composition in the direction of a core of each end face by 10% or more of die length to full [ of this honeycomb structure object in this direction ] from this passage inlet-port end-face periphery section or this passage outlet end-face periphery section.

[Claim 6] A honeycomb structure object given in any 1 term of claims 1-5 characterized by arranging in this a part of unsealed section [ at least ] of this plane of composition the restoration member which uses a heat-resistant inorganic material as a principal component.

[Claim 7] The honeycomb structure object according to claim 6 with which material strength of that the Young's modulus of this restoration member is 80% or less of the Young's modulus of a honeycomb member or this restoration member is characterized by the thing of thing \*\* smaller than the material strength of this honeycomb member for which either is satisfied at least.

[Claim 8] At least one sort of ceramics chosen from the group which the principal component of this honeycomb member becomes from cordierite, a mullite, an alumina, a spinel, silicon carbide, silicon nitride, lithium aluminium silicate, aluminum titanates, and such combination, or a honeycomb structure object given in any 1 term of claims 1, 3-7 which are Fe-Cr-aluminum system metals.

[Claim 9] A honeycomb structure object given in any 1 term of claims 1-8 characterized by supporting the

catalyst on the septum of this honeycomb member.

[Claim 10] The negotiation hole of a large number which it is divided by the septum and penetrated to a passage inlet-port end face and a passage outlet end face It has two or more \*\*\*\* suggestion \*\*\*\*\* honeycomb filter members alternately by this passage inlet-port end face and passage outlet end face which this negotiation hole penetrates. This honeycomb filter member in respect of being parallel to the direction of passage of this negotiation hole It joins to this honeycomb filter member by the joint material of this construction material substantially. The honeycomb filter with which it is the honeycomb filter which it comes to unify, and the plane of composition in this honeycomb filter member is characterized by having the unsealed section at least including the edge linked to the passage inlet-port end-face periphery section or the passage outlet end-face periphery section.

[Claim 11] The negotiation hole of a large number which it is divided by the septum and penetrated to a passage inlet-port end face and a passage outlet end face It has two or more \*\*\*\* suggestion \*\*\*\*\* honeycomb filter members alternately by this passage inlet-port end face and passage outlet end face which this negotiation hole penetrates. These two or more honeycomb filter members in respect of being parallel to the direction of passage of this negotiation hole It is the honeycomb filter which it joins and comes to unify by joint material. The base of this honeycomb filter member uses Metals Si and SiC as a principal component. Si content specified by Si/(Si+SiC) is 5 - 50 % of the weight. Si content as which this joint material uses Metals Si and SiC as a principal component, and is specified by Si/(Si+SiC) More [ equivalent / to the base of this honeycomb filter member joined / or / it ] And the honeycomb filter with which it is 10 - 80 % of the weight, and the plane of composition in this honeycomb filter member is characterized by having the unsealed section at least including the edge linked to the passage inlet-port end-face periphery section and/or the passage outlet end-face periphery section.

[Claim 12] The honeycomb filter according to claim 10 or 11 with which this joint material is characterized by being continuously arranged in this plane of composition.

[Claim 13] A honeycomb filter given in any 1 term of claims 10-12 characterized by preparing this unsealed section of this plane of composition in the direction of passage of this negotiation hole by 10% or more of die length to the overall length of this honeycomb filter in this direction from this passage inlet-port end-face periphery section or this passage outlet end-face periphery section.

[Claim 14] A honeycomb filter given in any 1 term of claims 10-13 characterized by preparing this unsealed section of this plane of composition in the direction of a core of each end face by 10% or more of die length to full [ of this honeycomb filter in this direction ] from this passage inlet-port end-face periphery section or this passage outlet end-face periphery section.

[Claim 15] A honeycomb filter given in any 1 term of claims 10-14 characterized by arranging in this a part of unsealed section [ at least ] of this plane of composition the restoration member which uses a heat-resistant inorganic material as a principal component.

[Claim 16] The honeycomb filter according to claim 15 with which material strength of that the Young's modulus of this restoration member is 80% or less of the Young's modulus of a honeycomb member or this restoration member is characterized by the thing of thing \*\* smaller than the material strength of this honeycomb member for which either is satisfied at least.

[Claim 17] A honeycomb filter given in any 1 term of claims 10, 12-16 which are at least one sort of ceramics chosen from the group which the principal component of this honeycomb filter member becomes from cordierite, a mullite, an alumina, a spinel, silicon carbide, silicon nitride, lithium aluminium silicate, aluminum titanates, and such combination, or a Fe-Cr-aluminum system metal.

[Claim 18] A honeycomb filter given in any 1 term of claims 10-17 characterized by supporting the catalyst on the septum of this honeycomb member.

[Claim 19] Raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, it dries, and a honeycomb object is acquired. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in this honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently The manufacture approach of the honeycomb structure object characterized by calcinating after joining these two or more honeycomb objects through this junctional zone and unifying.

[Claim 20] After kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, further, this honeycomb object is calcinated and a honeycomb





member is obtained. Subsequently The junctinal zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in this honeycomb member at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently The manufacture approach of the honeycomb structure object characterized by calcinating after joining these two or more honeycomb members through this junctinal zone and unifying.

[Claim 21] After kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, the appearance of this honeycomb object is processed further. Subsequently The junctinal zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in this honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently The manufacture approach of the honeycomb structure object characterized by calcinating after joining these two or more honeycomb objects through this junctinal zone and unifying.

[Claim 22] Raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, it dries, and a honeycomb object is acquired. Subsequently The junctinal zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in this honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently The manufacture approach of the honeycomb structure object characterized by processing an appearance after joining these two or more honeycomb objects through this junctinal zone and unifying, and calcinating after that.

[Claim 23] Further, after kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, it calcinates and a honeycomb member is obtained, after processing the appearance of this honeycomb object. Subsequently The junctinal zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in this honeycomb member at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently The manufacture approach of the honeycomb structure object characterized by calcinating after joining these two or more honeycomb members through this junctinal zone and unifying.

[Claim 24] Raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, and it dries, and considers as a honeycomb object. Subsequently After calcinating this honeycomb object and considering as a honeycomb member, the appearance of this honeycomb member is processed. Subsequently The junctinal zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in this honeycomb member at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently The manufacture approach of the honeycomb structure object characterized by calcinating after joining these two or more honeycomb members through this junctinal zone and unifying.

[Claim 25] The manufacture approach of a honeycomb structure object given in any 1 term of claims 19-24 characterized by forming this junctinal zone continuously.

[Claim 26] The manufacture approach of the honeycomb structure object characterized by processing further the appearance of the honeycomb structure object acquired by the approach given in any 1 term of claims 19-25.

[Claim 27] The manufacture approach of the honeycomb structure object characterized by applying the filler which uses a heat-resistant inorganic material as a principal component to a part of side face [ at least ] of the honeycomb structure object acquired by the manufacture approach given in any 1 term of claims 19-26.

[Claim 28] The manufacture approach of a honeycomb structure object given in any 1 term of claims 19-27 characterized by arranging the filler which uses a heat-resistant inorganic material as a principal component in a part of part [ at least ] in which the junctinal zone is not formed among the fields in which this junctinal zone was formed to the part.

[Claim 29] The manufacture approach of a honeycomb structure object given in any 1 term of claims 19-28 characterized by the principal component of this honeycomb object and this junctinal zone consisting of at

least one sort of ceramics chosen from the group which consists of cordierite, a mullite, an alumina, a spinel, silicon carbide, silicon nitride, lithium aluminium silicate, aluminum titanates, and such combination, a Fe-Cr-aluminum system metal, or metals Si and SiC.

[Claim 30] The manufacture approach of the honeycomb structure object with a catalyst characterized by supporting a catalyst after manufacturing a honeycomb structure object by the manufacture approach of a publication in any 1 term of claims 19-29.

[Claim 31] Raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, it dries, and a honeycomb object is acquired. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of this honeycomb object is alternately \*\*\*\*\*\*(ed) by this passage inlet-port end face and this passage outlet end face, and a \*\*\*\*\* honeycomb object is produced. Subsequently Substantially the junctional zone which serves as this honeycomb object from this construction material substantially with the direction of passage of this negotiation hole in this \*\*\*\*\* honeycomb object to an parallel field The manufacture approach of the honeycomb filter which forms in a part except for the edge which connects with the passage inlet-port end-face periphery section or the passage outlet end-face periphery section at least, and is subsequently characterized by calcinating after joining these two or more \*\*\*\*\* honeycomb objects through this junctional zone and unifying.

[Claim 32] After kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, further, this honeycomb object is calcinated and a honeycomb member is obtained. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of this honeycomb member is alternately \*\*\*\*\*\*(ed) by this passage inlet-port end face and this passage outlet end face, and a honeycomb filter member is produced. Subsequently Substantially the junctional zone which serves as this honeycomb object from this construction material substantially with the direction of passage of this negotiation hole in this honeycomb filter member to an parallel field The manufacture approach of the honeycomb filter which forms in a part except for the edge which connects with the passage inlet-port end-face periphery section or the passage outlet end-face periphery section at least, and is subsequently characterized by calcinating after joining these two or more honeycomb filter members through this junctional zone and unifying.

[Claim 33] Raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, it dries, and a honeycomb object is acquired. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of this honeycomb object is alternately \*\*\*\*\*\*(ed) by this passage inlet-port end face and this passage outlet end face, and a \*\*\*\*\* honeycomb object is produced. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of this negotiation hole in this \*\*\*\*\* honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently The manufacture approach of the honeycomb filter characterized by processing an appearance after joining these two or more \*\*\*\*\* honeycomb objects through this junctional zone and unifying, and calcinating after that.

[Claim 34] After kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, the appearance of this honeycomb object is processed further. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of this honeycomb object is alternately \*\*\*\*\*\*(ed) by this passage inlet-port end face and this passage outlet end face, and a \*\*\*\*\* honeycomb object is produced. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of this negotiation hole in this \*\*\*\*\* honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently The manufacture approach of the honeycomb filter characterized by calcinating after joining these two or more \*\*\*\*\* honeycomb objects through this junctional zone and unifying.

[Claim 35] Further, after kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, it calcinates and a honeycomb member is obtained, after processing the appearance of this honeycomb object. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of this honeycomb member is alternately \*\*\*\*\*\*(ed) by this passage inlet-port end face and this passage outlet end face, and a honeycomb

filter member is produced. Subsequently Substantially the junctinal zone of this construction material with the direction of passage of the negotiation hole in this honeycomb filter member as substantially as this honeycomb object to an parallel field The manufacture approach of the honeycomb filter which forms in a part except for the edge which connects with the passage inlet-port end-face periphery section or the passage outlet end-face periphery section at least, and is subsequently characterized by calcinating after joining these two or more honeycomb filter members through this junctinal zone and unifying.

[Claim 36] Raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, and it dries, and considers as a honeycomb object. Subsequently After calcinating this honeycomb object and considering as a honeycomb member, the appearance of this honeycomb member is processed. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of this honeycomb member is alternately \*\*\*\*\*\*(ed) by this passage inlet-port end face and this passage outlet end face, and a honeycomb filter member is produced. Subsequently Substantially the junctinal zone of this construction material with the direction of passage of the negotiation hole in this honeycomb filter member as substantially as this honeycomb object to an parallel field The manufacture approach of the honeycomb filter which forms in a part except for the edge which connects with the passage inlet-port end-face periphery section or the passage outlet end-face periphery section at least, and is subsequently characterized by calcinating after joining these two or more honeycomb filter members through this junctinal zone and unifying.

[Claim 37] The manufacture approach of a honeycomb filter given in any 1 term of claims 31-36 characterized by forming this junctinal zone continuously.

[Claim 38] The manufacture approach of the honeycomb filter characterized by processing further the appearance of the honeycomb filter obtained by the approach given in any 1 term of claims 31-37.

[Claim 39] The manufacture approach of the honeycomb filter characterized by applying the filler which uses a heat-resistant inorganic material as a principal component to a part of side face [ at least ] of the honeycomb filter obtained by the manufacture approach given in any 1 term of claims 31-38.

[Claim 40] The manufacture approach of a honeycomb filter given in any 1 term of claims 31-39 characterized by arranging the filler which uses a heat-resistant inorganic material as a principal component in a part of part [ at least ] in which the junctinal zone is not formed among the fields in which this junctinal zone was formed to the part.

[Claim 41] The manufacture approach of a honeycomb filter given in any 1 term of claims 31-40 characterized by the principal component of this honeycomb object and this jointing material for corrugated fibreboard consisting of at least one sort of ceramics chosen from the group which consists of cordierite, a mullite, an alumina, a spinel, silicon carbide, silicon nitride, lithium aluminium silicate, aluminum titanates, and such combination, a Fe-Cr-aluminum system metal, or metals Si and SiC.

[Claim 42] The manufacture approach of the honeycomb filter with a catalyst characterized by supporting a catalyst after manufacturing a honeycomb filter by the manufacture approach of a publication in any 1 term of claims 31-41.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the honeycomb structure objects for catalyst support and honeycomb filters which are used for the exhaust gas purge of burners, such as heat engines, such as an internal combustion engine, or a boiler, the reformer of liquid fuel or gaseous fuel, etc., and those manufacture approaches.

[0002]

[Description of the Prior Art] Conventionally, the honeycomb structure object which supported the catalyst component is used for the exhaust gas purge of burners, such as heat engines, such as an internal combustion engine, or a boiler, the reformer of liquid fuel or gaseous fuel, etc. Moreover, in order to carry out uptake clearance of the particulate matter contained in dust-containing fluid like the exhaust gas discharged from a diesel power plant, using a honeycomb filter is known.

[0003] It was exposed to a temperature change with rapid exhaust gas, or local generation of heat, and was easy to produce uneven temperature distribution inside, and the honeycomb structure object or honeycomb filter used for such the object had the problem of a crack occurring owing to it. When used as a honeycomb filter which carries out the collection of the particulate matter under exhaust air of a diesel power plant especially, it was required to burn the collected carbon particle and to remove, and since local elevated-temperature-ization was not avoided in this case, it is easy to generate big thermal stress, and was easy to generate a crack. Here, generating of thermal stress is because each part of each other is restrained by the ununiformity of temperature distribution and cannot deform freely with it to thermal expansion deformation of each part of a honeycomb structure object differing.

[0004] Moreover, when a honeycomb structure object is enlarged more in activity eye, creating the honeycomb structure object or honeycomb filter which joined two or more honeycomb members by joint material, and was unified is known, and the device which reduces the thermal stress generated also in this case is needed.

[0005] As a policy which reduces thermal stress, the manufacture approach of the honeycomb structure object which joins many honeycomb members to the conventional No. 4335783, for example, USP, official report by discontinuous joint material is indicated. However, since it was not taken into consideration that thermal stress occurs with this honeycomb structure object near the ends side periphery section which a negotiation hole mainly penetrates, it was not what not necessarily eases thermal stress fully. Moreover, since joint material was prepared discontinuously, the bonding strength of a honeycomb member was not enough and the mechanical strength of the honeycomb structure object acquired was not necessarily enough.

[0006] Moreover, after carrying out extrusion molding of the matrix member of the honeycomb structure which consists of a ceramic ingredient to JP,61-51240,B, processing the periphery section after baking and making it smooth, it is substantially [ as a matrix member ] the same, and the thermal-shock-resistance revolution heat-regenerative element with which the difference of an thermal expansion coefficient applies and calcinates [ the mineral composition after calcinating to the joint ] the ceramic jointing material for corrugated fibreboard which becomes with 0.1% or less in 800 degrees C is proposed. However, although thermal stress mainly occurs near the periphery section of a passage inlet-port end face and a passage outlet end face, since the honeycomb member was joined in these ends side periphery section, this thermal-shock-resistance revolution heat-regenerative element was not what not necessarily eases thermal stress fully, either.

[0007] Moreover, the ceramic honeycomb filter which similarly joined the honeycomb member of cordierite to

the SAE paper 860008 in 1986 into cordierite cement is indicated, and it is. However, it was not what is the same as that of the above-mentioned honeycomb structure object etc., and not necessarily eases thermal stress fully too in that this honeycomb filter is joined to the passage inlet-port end-face periphery section and the outlet end-face periphery section.

[0008] Furthermore, the ceramic honeycomb filter which pasted up the inorganic fiber which is each other interwoven with in three dimensions at least in two or more honeycomb ceramic members, and the inorganic particle on JP,8-28246,A by the nature seal member of elasticity which it comes to join mutually together through an inorganic binder and an organic binder is indicated. However, this honeycomb filter also had the trouble that a honeycomb member and a seal member could not ease the thermal stress generated in that end face again not this construction material but since it has pasted up to the passage inlet-port end-face periphery section and the outlet end-face periphery section.

[0009]

[Problem(s) to be Solved by the Invention] This invention is made in view of such a conventional technical problem, and the place made into the object is to offer the honeycomb structure object excellent in the endurance which the crack initiation by the thermal stress at the time of an activity does not produce, honeycomb filters, and those manufacture approaches.

[0010]

[Means for Solving the Problem] According to this invention, two or more preparations and two or more of these honeycomb members substantially the honeycomb member which has the negotiation hole of a large number divided by the septum with a honeycomb member by the joint material of this construction material It is the honeycomb structure object with which it is substantially joined to the direction of passage of a negotiation hole in respect of being parallel, and comes to unify these two or more honeycomb members. The honeycomb structure object with which the plane of composition in a honeycomb member is characterized by having the unsealed section at least including the edge linked to the passage inlet-port end-face periphery section and/or the passage outlet end-face periphery section is offered.

[0011] According to this invention, moreover, the negotiation hole of a large number which it is divided by the septum and penetrated to a passage inlet-port end face and a passage outlet end face It has two or more \*\*\*\* suggestion \*\*\*\*\* honeycomb filter members alternately by the passage inlet-port end face and passage outlet end face which a negotiation hole penetrates. This honeycomb filter member substantially with this honeycomb filter member by the joint material of this construction material It is the honeycomb filter with which a field parallel to the direction of passage of this negotiation hole is joined, and it comes to unify these two or more honeycomb members. The honeycomb filter with which the plane of composition in this honeycomb filter member is characterized by having the unsealed section at least including the edge linked to the passage inlet-port end-face periphery section or the passage outlet end-face periphery section is offered.

[0012] In these honeycomb structure object and a honeycomb filter ("it may abbreviate to a honeycomb structure object etc." hereafter, and it may say) Si content specified by Si/(Si+SiC) of a honeycomb member by the principal component of a honeycomb member and joint material consisting of metals Si and SiC is 5 - 50 % of the weight. Si content specified by Si/(Si+SiC) of joint material shall be equivalent to the honeycomb member joined, there shall be than it, and they shall be 10 - 80 % of the weight. [ more ]

[0013] Moreover, it sets on the honeycomb structure object of this invention etc. It is desirable that joint material is continuously arranged in a plane of composition. The unsealed section of a plane of composition It is prepared in the direction of passage of a negotiation hole by 10% or more of die length to the overall length of the honeycomb structure object in this direction from the passage inlet-port end-face periphery section or the passage outlet end-face periphery section, Or it is desirable to be prepared in the direction of a core of each end face by 10% or more of die length to full [ of the honeycomb structure object in this direction ] from the passage inlet-port end-face periphery section or the passage outlet end-face periphery section.

[0014] Furthermore, in the honeycomb structure object of this invention etc., it is desirable that the restoration member which uses a heat-resistant inorganic material as a principal component is arranged in a part of unsealed section [ at least ] of a plane of composition, and the thing of thing \*\* with the material strength of that the Young's modulus of a restoration member is 80% or less of the Young's modulus of a honeycomb member or a restoration member smaller than the material strength of a honeycomb member for which either is satisfied at least is desirable in this case.

[0015] It is desirable that they are at least one sort of ceramics chosen from the group which the principal component of a honeycomb member becomes from cordierite, a mullite, an alumina, a spinel, silicon carbide, silicon nitride, lithium aluminium silicate, aluminum titanates, and such combination in the honeycomb structure object of this invention etc. further again, or a Fe-Cr-aluminum system metal. Moreover, a catalyst can also be made to support on the septum of a honeycomb member.

[0016] According to this invention, raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, it dries, and a honeycomb object is acquired. On the other hand, subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining two or more honeycomb objects through a junctional zone and unifying, the manufacture approach of the honeycomb structure object characterized by calcinating is offered.

[0017] After according to this invention kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, further, a honeycomb object is calcinated and a honeycomb member is obtained. Moreover, subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a honeycomb member at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining two or more honeycomb members through a junctional zone and unifying, the manufacture approach of the honeycomb structure object characterized by calcinating is offered.

[0018] After according to this invention kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, the appearance of a honeycomb object is processed further. Furthermore, subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining these two or more honeycomb objects through a junctional zone and unifying, the manufacture approach of the honeycomb structure object characterized by calcinating is offered.

[0019] According to this invention, raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, it dries, and a honeycomb object is acquired further again. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in this honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as this honeycomb object. Subsequently After joining these two or more honeycomb objects through this junctional zone and unifying, an appearance is processed and the manufacture approach of the honeycomb structure object characterized by calcinating after that is offered.

[0020] Further, after according to this invention kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object further again, it calcinates and a honeycomb member is obtained, after processing the appearance of a honeycomb object. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a honeycomb member at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining two or more honeycomb members through a junctional zone and unifying, the manufacture approach of the honeycomb structure object characterized by calcinating is offered.

[0021] According to this invention, raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, and it dries, and considers as a honeycomb object further again. Subsequently After calcinating a honeycomb object and considering as a honeycomb member, the appearance of a honeycomb member is processed. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a honeycomb member at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining

these two or more honeycomb members through a junctional zone and unifying, the manufacture approach of the honeycomb structure object characterized by calcinating is offered.

[0022] According to this invention, raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, it dries, and a honeycomb object is acquired. On the other hand, subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of a honeycomb object is alternately \*\*\*\*\*\*(ed) by the passage inlet-port end face and the passage outlet end face, and a \*\*\*\*\* honeycomb object is produced. Subsequently The junctional zone which serves as a honeycomb object from this construction material substantially is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a \*\*\*\*\* honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section. Subsequently After joining two or more \*\*\*\*\* honeycomb objects through a junctional zone and unifying, the manufacture approach of the honeycomb filter characterized by calcinating is offered.

[0023] After according to this invention kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object, further, a honeycomb object is calcinated and a honeycomb member is obtained. Moreover, subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of a honeycomb member is alternately \*\*\*\*\*\*(ed) by the passage inlet-port end face and the passage outlet end face, and a honeycomb filter member is produced. Subsequently Substantially the junctional zone which serves as a honeycomb object from this construction material substantially with the direction of passage of the negotiation hole in a honeycomb filter member to an parallel field It forms in a part except for the edge which connects with the passage inlet-port end-face periphery section or the passage outlet end-face periphery section at least, and subsequently, after joining two or more honeycomb filter members through a junctional zone and unifying, the manufacture approach of the honeycomb filter characterized by calcinating is offered.

[0024] According to this invention, raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, it dries, and a honeycomb object is acquired. Furthermore, subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of a honeycomb object is alternately \*\*\*\*\*\*(ed) by the passage inlet-port end face and the passage outlet end face, and a \*\*\*\*\* honeycomb object is produced. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a \*\*\*\*\* honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining two or more \*\*\*\*\* honeycomb objects through a junctional zone and unifying, an appearance is processed and the manufacture approach of the honeycomb filter characterized by calcinating after that is offered.

[0025] After according to this invention kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object further again, the appearance of a honeycomb object is processed further. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of a honeycomb object is alternately \*\*\*\*\*\*(ed) by the passage inlet-port end face and the passage outlet end face, and a \*\*\*\*\* honeycomb object is produced. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a \*\*\*\*\* honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining two or more \*\*\*\*\* honeycomb objects through a junctional zone and unifying, the manufacture approach of the honeycomb filter characterized by calcinating is offered.

[0026] Further, after according to this invention kneading, fabricating the obtained kneading object, drying and using raw material powder, a binder, and water as a honeycomb object further again, it calcinates and a honeycomb member is obtained, after processing the appearance of a honeycomb object. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of a honeycomb member is alternately \*\*\*\*\*\*(ed) by the passage inlet-port end face and the passage outlet end face, and a honeycomb filter member is produced. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation

hole in a honeycomb filter member at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining two or more honeycomb filter members through a junctional zone and unifying, the manufacture approach of the honeycomb filter characterized by calcinating is offered.

[0027] According to this invention, raw material powder, a binder, and water are kneaded, and the obtained kneading object is fabricated, and it dries, and considers as a honeycomb object further again. Subsequently After calcinating this honeycomb object and considering as a honeycomb member, the appearance of this honeycomb member is processed. Subsequently The negotiation hole of a large number penetrated to the passage inlet-port end face and passage outlet end face of this honeycomb member is alternately \*\*\*\*\*\*(ed) by the passage inlet-port end face and the passage outlet end face, and a honeycomb filter member is produced. Subsequently The junctional zone of this construction material is formed in a part except for the edge which connects with the direction of passage of the negotiation hole in a honeycomb filter member at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section as substantially as a honeycomb object. Subsequently After joining two or more honeycomb filter members through a junctional zone and unifying, the manufacture approach of the honeycomb filter characterized by calcinating is offered.

[0028] It is desirable to form a junctional zone continuously by the manufacture approaches, such as these honeycomb structure object. Moreover, the appearance of the acquired honeycomb structure object may be processed further.

[0029] Moreover, it is desirable to apply to a part of side face [ at least ] of a honeycomb structure object etc. the filler which uses a heat-resistant inorganic material as a principal component, and it may support a catalyst after manufacturing a honeycomb structure object etc.

[0030] Moreover, it is desirable to arrange the filler which uses a heat-resistant inorganic material as a principal component in a part of part [ at least ] in which the junctional zone of the field in which the junctional zone was formed to the part is not formed.

[0031] It is desirable to consist of at least one sort of ceramics chosen from the group which consists of cordierite, a mullite, an alumina, a spinel, silicon carbide, silicon nitride, lithium aluminium silicate, aluminum titanates, and such combination as a honeycomb member and a principal component of a junctional zone, a Fe-Cr-aluminum system metal, or metals Si and SiC.

[0032]

[Embodiment of the Invention] the coefficient of thermal expansion at the time of the filter activity of a honeycomb member and joint material since the honeycomb structure object of this invention etc. is joined by the joint material of this construction material as substantially [ two or more honeycomb members or honeycomb filter members (hereafter, "it can be abbreviating to the honeycomb member etc." and there are things.) ] as a honeycomb member -- abbreviation -- it becomes the same and generating of thermal stress can be controlled.

[0033] As for thermal stress, according to examination, it turns out [ of this invention person ] wholeheartedly in the passage inlet-port end-face periphery section or the passage outlet end-face periphery section that it is very large. Moreover, in this invention Since it constitutes including at least the edge which connects a plane of composition to this part so that it may have the unsealed section in a part, In addition to the thermal stress reduction effectiveness by the jointing material for corrugated fibreboard mentioned above, the thermal stress generated on a honeycomb structure object etc. still more effectively can be reduced, and it can consider as the honeycomb structure object which a crack etc. does not generate and which is excellent in endurance.

[0034] Hereafter, each requirement for a configuration, such as a honeycomb structure object concerning this invention, is explained in detail.

[0035] the negotiation hole of a large number which the honeycomb structure object concerning this invention comes to unify two or more honeycomb members which have the negotiation hole of a large number divided by the septum, and the honeycomb filter of this invention is divided by the septum, and are penetrated to a passage inlet-port end face and a passage outlet end face -- a passage inlet-port end face and a passage outlet end face -- alternate -- \*\*\*\* suggestion -- \*\*\*\* -- it comes to unify two or more honeycomb filter members.

[0036] As for the cross-section configuration (cel configuration) of a negotiation hole, in the honeycomb member in this invention etc., it is desirable that it is either of the viewpoint on a fabrication to triangles,

squares, hexagons, or corrugated configurations.

[0037] Moreover, the cel consistency of the cel formed by the septum has desirable 6-2000 cel / square inch (0.9 - 311 cel / cm<sup>2</sup>) in consideration of the reinforcement as a honeycomb member and Validity GSA (geometric surface area), and pressure loss in case gas flows further, and its 50-400 cel / square inch (7.8 - 62 cel / cm<sup>2</sup>) are still more desirable.

[0038] Moreover, the thing of a configuration from which the shape of a cylindrical shape is cut to trichotomy or quadrisection at shaft orientations so that it may pass along the medial axis, and the cross-section configurations of shaft orientations and a perpendicular direction serve as a sector in it as a configuration of a honeycomb member, for example; the shape of a cylindrical shape can be cut at fixed spacing to shaft orientations at 9 or more \*\*\*\*'s, and the cross-section configurations of shaft orientations and a perpendicular direction can mention the thing used as a configuration which is [ rectangular head / a sector ] different by each segment etc. The thing of a configuration which cut the honeycomb member from the point that the thermal stress of a honeycomb filter can be reduced by establishing the contact surface in three dimension in large numbers especially, to 9 or more \*\*\*\*'s is desirable.

[0039] On the other hand, the honeycomb member in this invention has desirable silicon carbide at the point that it is desirable to consist of at least one sort of ceramics chosen from the group which consists of cordierite, a mullite, an alumina, a spinel, silicon carbide, silicon nitride, lithium aluminium silicate, aluminum titanates, and such combination, and a Fe-Cr-aluminum system metal, and thermal conductivity tends to radiate heat highly especially from viewpoints, such as reinforcement and thermal resistance.

[0040] Moreover, in this invention, it is also desirable to use Metals Si and SiC as a principal component, in this case, it is desirable that Si content specified by Si/(Si+SiC) of a honeycomb member is 5 - 50 % of the weight, and it is still more desirable to it that it is 10 - 40 % of the weight. Since less than 5 % of the weight of association by Si is insufficient, thermal conductivity and reinforcement may be insufficient, and if it, on the other hand, exceeds 50 % of the weight, it may contract too much, and evils, such as porosity lowering and a pore diameter cutback, may be produced.

[0041] In this invention, what especially a limit does not have about the \*\*\*\*\* member which \*\*\*\*\* a negotiation hole, for example, consists of the same ceramics and/or same metal as a honeycomb member can be mentioned.

[0042] After fabricating the kneading object kneaded and obtained after the honeycomb member carried out the specified quantity charge of a binder and the water in this invention at the raw material powder which consists of the ceramics and/or metal which were mentioned above and making it into a desired configuration, desiccation of a Plastic solid can be performed, a honeycomb object can be acquired, and, finally it can obtain by calcinating this honeycomb object.

[0043] before junction by the jointing material for corrugated fibreboard later mentioned in order that the honeycomb member in this invention may raise dimensional accuracy -- the appearance -- processing it -- substance is desirable. Moreover, processing of this appearance may be performed to the honeycomb object fabricated and acquired.

[0044] As a binder used by this invention, a hydroxymethyl cellulose, methyl cellulose, hydroxyethyl cellulose, carboxyl methyl cellulose, or polyvinyl alcohol can be mentioned, and these binders are kind independent or can be used combining two or more sorts, for example.

[0045] Moreover, in addition to this in this invention, the ethylene glycol generally used as a shaping assistant, a dextrin, fatty-acid soap, or polyalcohol may be added if needed.

[0046] To the powder raw material 100 weight section mentioned above, the amount of the water to throw in is 10 - 40 weight section extent, after throwing in water, kneads the obtained mixed raw material with a vacuum kneading machine etc., and usually makes it plasticity.

[0047] The shaping approach has desirable extrusion molding, for example, it can perform it using a ram type extrusion-molding machine, biaxial screw-type continuous-extrusion-molding equipment, etc.

[0048] Moreover, it is desirable to be able to mention hot air drying, microwave desiccation, dielectric drying, reduced pressure drying, a vacuum drying, freeze drying, etc., and to carry out by being independent or combining dielectric drying, microwave, or hot air drying especially as the desiccation approach, for example. Furthermore, what is necessary is just to choose desired conditions suitably about baking conditions according to the class of ingredient to be used.

[0049] Moreover, in the honeycomb filter of this invention, in case a negotiation hole is \*\*\*\*\* (ed), the negotiation hole of the honeycomb object after shaping desiccation is \*\*\*\*\* (ed), and it is good also as a \*\*\*\*\* honeycomb object, and the negotiation hole of the honeycomb member after calcinating further is \*\*\*\*\* (ed), and it is good also as a honeycomb filter member. It is desirable that the bonding strength of a \*\*\*\*\* member \*\*\*\*\* the negotiation hole of a honeycomb object, and considers as a \*\*\*\*\* honeycomb object at a large point especially.

[0050] In this invention, it has the unsealed section including the edge which an parallel field is substantially joined to the direction of passage of a negotiation hole by the joint material to which two or more honeycomb members etc. turn into a honeycomb member from the principal component of this construction material substantially, it comes to be unified, and a plane of composition connects to the passage inlet-port end-face periphery section or the passage outlet end-face periphery section at least by it.

[0051] Here, a "plane of composition" means the field where the jointing material for corrugated fibreboard is arranged in the part among this description. Moreover, the "unsealed section" means the part in which a jointing material for corrugated fibreboard is not arranged among planes of composition. Furthermore, it is semantics also including the field which is not parallel in semantics strict in the range acting as [ in case two or more honeycomb members are joined to "it is an parallel field substantially" ] a failure.

[0052] In this invention, although what is nonsequentially arranged in the plane of composition by two or more places, the thing currently continuously arranged in the plane of composition, and \*\*\*\*\* are sufficient as joint material, it is the point which can make bonding strength, such as a honeycomb member, high, and what is continuously arranged in the plane of composition is desirable.

[0053] Moreover, as a configuration of joint material, although the cross-section configuration of the shaft orientations of a honeycomb structure object can, for example, mention a triangle, a rectangle, a square, a rhombus, a trapezoid, an ellipse, circular, a truck circle configuration, a half-ellipse form, or a semicircle, it is the point which is easy to equalize the temperature of the whole filter, and an ellipse, circular, a truck circle configuration, etc. are desirable.

[0054] As for the unsealed section, it is desirable to be formed in the direction of passage of a negotiation hole by 10% or more of die length to the overall length of the honeycomb structure object of this direction etc. from the passage inlet-port end-face periphery sections, such as a honeycomb structure object, or the passage outlet end-face periphery section, and it is more desirable to be formed by 30% or more of die length. If it is this range, the thermal stress of the whole, such as a honeycomb structure object, can be reduced effectively, generating of a crack etc. can be controlled, and endurance can be raised.

[0055] Moreover, as for the unsealed section, it is still more desirable to be formed in the direction of a core of each end face by 10% or more of die length to full [ of the honeycomb structure object of this direction etc. ] from the passage inlet-port end-face periphery sections, such as a honeycomb structure object, or the passage outlet end-face periphery section, and it is more desirable to be formed by 30% or more of die length. Thereby, thermal stress can be reduced more and endurance can be raised further.

[0056] Moreover, in this invention, it is desirable that prepare a joint in abbreviation cores, such as a honeycomb structure object, and the unsealed section is prepared including all the parts linked to the side face of the honeycomb structure object in a plane of composition etc., a passage outlet end face, and a passage inlet-port end face. Deformation of each part which thermal stress tends to generate with a honeycomb structure object etc. becomes possible easily by this, and generating of a crack etc. can be controlled to altitude.

[0057] furthermore, this invention -- if it is, the unsealed section is the point which cannot produce a bias easily in deformation of each part, it is desirable to be arranged on the basis of medial axes, such as a honeycomb structure object, at axial symmetry, but as shown in drawing 11 (a) - (d), the unsealed section 12 may be arranged to non-axial symmetry on the basis of medial axes, such as a honeycomb structure object, for example.

[0058] On the other hand, the jointing material for corrugated fibreboard in this invention is the thing of this construction material as substantially as a honeycomb member as above-mentioned.

[0059] It consists of at least one sort of ceramics chosen from the group which specifically consists of the cordierite described by the way, the mullite, the alumina, the spinel, the silicon carbide, the silicon nitride, the lithium aluminium silicate, the aluminum titanates, and such combination of a honeycomb member, or a Fe-Cr-aluminum system metal, and the component of a honeycomb member and the thing made to correspond can be

mentioned.

[0060] On the other hand, although it is desirable to use Metals Si and SiC as a principal component also as for a jointing material for corrugated fibreboard when a honeycomb member uses Metals Si and SiC as a principal component, in this case, Si content specified by Si/(Si+SiC) is equivalent to the honeycomb member joined, to it, and it is desirable than it to it that it is 10 - 80 % of the weight. If bonding strength sufficient by under the EQC may not be obtained compared with a honeycomb member and Si content exceeds 80 % of the weight, the oxidation resistance in an elevated temperature may become inadequate.

[0061] In this invention, as substantially as a honeycomb object, joint material can prepare it by calcinating, after forming the junctional zone of this construction material in a part except for the edge which connects with the direction of passage of the negotiation hole in a honeycomb object at least substantially in an parallel field at the passage inlet-port end-face periphery section or the passage outlet end-face periphery section.

[0062] But in the honeycomb structure object of this invention, after a junctional zone forms in the honeycomb member which calcinated the honeycomb object after shaping and desiccation further, and acquired it, joint material can also be prepared by calcinating. moreover, the honeycomb filter of this invention -- also setting -- the negotiation hole of a honeycomb object -- \*\*\*\*\* -- eye the bottom -- \*\*\* -- a honeycomb -- the body -- joint material may be prepared by calcinating, after a junctional zone forms, and after a junctional zone forms in the honeycomb filter member which \*\*\*\*\* (ed) the honeycomb member, joint material may be prepared by calcinating.

[0063] Although the slurry of this construction material may be substantially applied to a predetermined field directly with a honeycomb object as an approach of forming a junctional zone, in order to secure predetermined thickness, it is desirable to apply the slurry of this construction material to this, and to join to it using the plate of the predetermined thickness which is the thing of the same construction material and was formed. Moreover, as for a junctional zone, forming continuously is desirable in order to enlarge bonding strength, such as a honeycomb member.

[0064] The honeycomb structure object of this invention etc. can be calcinated and acquired after unifying the honeycomb object which formed the junctional zone in this way, or the plurality of \*\*. Baking conditions should just choose suitable heat treatment temperature suitably according to the ingredient of a jointing material for corrugated fibreboard that what is necessary is just suitable conditions, when joining. However, it is desirable to carry out at the temperature of 200-400 degrees C generally.

[0065] In this invention, it is desirable that the restoration member which uses a heat-resistant inorganic material as a principal component is arranged in a part of unsealed section [ at least ]. Thereby, the blow by (passing through) from the unsealed section of fluids, such as gas, can be prevented.

[0066] In addition, when arranging a restoration member in the honeycomb filter of this invention, it is desirable to arrange in a part of unsealed section so that all the parts in which the opening formed of the unsealed section at least exposes a restoration member to a passage inlet-port end face may be blockaded. While being able to prevent by this that soot accumulates on the unsealed section, the thermal stress produced in a honeycomb filter by the opening exposed between the restoration member arranged in the passage inlet-port end-face 16 side and a jointing material for corrugated fibreboard and to the passage outlet end face 14 can be reduced to altitude.

[0067] Being independent, or mixing and using the ceramic fiber which has thermal resistance, ceramic powder, cement, etc. as a restoration member which uses a heat-resistant inorganic material as a principal component, may mix and use an organic binder, an inorganic binder, etc. preferably if needed further.

[0068] Moreover, the thing of thing \*\* with that \*\* Young's modulus is 80% or less of the Young's modulus of a honeycomb member and \*\* material strength smaller than the material strength of a honeycomb member as a restoration member in this invention for which either is satisfied at least is desirable, and it is more desirable to satisfy these both.

[0069] At least, when one of these is satisfied, the thermal stress reduction effectiveness is large and it is because the endurance of a honeycomb structure object etc. improves further. Here, Young's modulus carries out measurement calculation from the relation between a load and the amount of displacement by the static-modulus examining method, and material strength is measured by the four-point bending test (JIS1601) using a material testing machine.

[0070] In this invention, it is also desirable to apply the filler further mentioned above on a part of side face [ at

least ] of the acquired honeycomb structure object, and to raise thermal resistance.

[0071] In addition, after a restoration member unifies and calcinates honeycomb objects, such as a honeycomb member, etc., it is filled up with a filler, you may calcinate and arrange if needed further, and after it unifies, and it is filled up with a filler before calcinating, desiccation and, with honeycomb objects, such as a honeycomb member, etc., it may be calcinated and may arrange it.

[0072] Moreover, in this invention, in consideration of dimension doubling, such as a container, etc., after unifying, appearances (honeycomb structure object etc.), such as a honeycomb member, may be processed, and after calcinating further, appearances (honeycomb structure object etc.), such as a honeycomb member, may be processed.

[0073] In this invention, as for the unified honeycomb structure object etc., a vertical cross-section configuration can take various kinds of configurations, such as a circle, an ellipse, and a ball-race truck, in the direction of passage of a negotiation hole.

[0074] moreover, the metal which has catalyst ability, such as Pt, Pd, and Rh, in a honeycomb member etc. in this invention when it is going to use such a honeycomb structure object etc. for refining or clarification of the exhaust gas of burners, such as heat engines, such as an internal combustion engine, or a boiler, liquid fuel, or gaseous fuel as catalyst support -- even if few, it is desirable to support one sort.

[0075] Moreover, if the caught particulate matter accumulates on a septum in using as a honeycomb filter, since blinding will be started and the function as a filter will fall, by heating a honeycomb filter with heating means, such as a heater, periodically, combustion clearance of the particulate matter is carried out, and it performs reproducing a filter. Therefore, in order to promote combustion of the particulate matter at the time of filter playback, the metal which has such catalyst ability on a septum may be made to support in the case of a honeycomb filter.

[0076] Although this invention is hereafter explained further to a detail based on the operation gestalt shown in a drawing, this invention is not limited to these operation gestalten.

[0077] Drawing 1 (a), (b), (c), and (d) are the perspective views showing the various examples of the honeycomb structure object concerning this invention. The honeycomb structure object 10 shown in drawing 1 (a), (b), (c), and (d) joins four honeycomb members 21 which have the negotiation hole 11 of a large number penetrated to the shaft orientations (the direction of passage) (it is drawing 1 (a), (b), (c), and (d), and the direction of X shows.) divided by the septum, and is constituted. Moreover, the honeycomb member 21 is substantially joined to the direction X of passage of the negotiation hole 11 by the joint material 25 of this construction material in respect of [ 22 ] being parallel (plane of composition) as substantially as the honeycomb member 21, among this plane of composition 22, the unsealed section 12 is formed including the edge 18 linked to the passage outlet end-face periphery section 15, and the joint material 25 is arranged continuously.

[0078] Here, including a part of part which the unsealed section 12 connects to the passage outlet end face 14 and a side face 13 among planes of composition 22, from the side face 13, the honeycomb structure object 10 shown in drawing 1 (a) is aslant formed so that the width of face of the direction Y of a core of the honeycomb structure object 10 may become small gradually in the passage inlet-port end-face 16 direction. Moreover, although the unsealed section 12 is formed including a part of part which connects with the passage outlet end face 14 and a side face 13 similarly, the configuration of the unsealed section 12 is a rectangle, and the honeycomb structure object 10 shown in drawing 1 (b) is formed from the side face 13 so that the width of face of the direction Y of a core of the honeycomb structure object 10 may become the same in the passage inlet-port end-face 16 direction. Moreover, including the part which the unsealed section 12 connects with the whole part which connects with a side face 13 among planes of composition 22 at the passage outlet end face 14, from the side face 13, the honeycomb structure object 10 shown in drawing 1 R> 1 (c) is aslant formed so that the width of face of the direction Y of a core of the honeycomb structure object 10 may become small gradually in the passage inlet-port end-face 16 direction. Moreover, including the part which the unsealed section 12 connects to the whole part, the passage outlet end face 14, and the passage inlet-port end face 16 which are connected to a side face 13 among planes of composition 22, from the side face 13, the honeycomb structure object 10 shown in drawing 1 (d) is formed so that the width of face of the direction Y of a core of the honeycomb structure object 10 may become the same in the direction of a passage outlet end face.

[0079] With the honeycomb structure object 10 shown in drawing 1 (a), (b), (c), and (d), even if the

ununiformity of temperature distribution like a local elevated temperature or low temperature arises, it can deform freely, without restraining each part of the honeycomb structure object 10 mutually, thermal stress is reduced, and generating of a crack is prevented as much as possible.

[0080] Since the effectiveness of reducing thermal stress by the honeycomb structure object 10 whole especially with the honeycomb structure object 10 shown in drawing 1 (c) and (d) is large, especially in an operating environment by which the ununiformity of temperature attains to the honeycomb structure object 10 whole, it is effective.

[0081] The honeycomb structure object 10 shown in drawing 2 (a) and (b) joins three honeycomb members 21, and is constituted. Including the part which the unsealed section 12 connects with the whole part which connects with a side face 13 among planes of composition 22 like drawing 1 R>1 (c) at the passage outlet end face 14, from the side face 13, the honeycomb structure object 10 shown in drawing 2 (a) is aslant formed so that the width of face of the direction Y of a core of the honeycomb structure object 10 may become small gradually in the passage inlet-port end-face 16 direction. Moreover, like drawing 1 (d), including the part which the unsealed section 12 connects to the whole part, the passage outlet end face 14, and the passage inlet-port end face 16 which are connected to a side face 13 among planes of composition 22, from the side face 13, the honeycomb structure object 10 shown in drawing 2 (b) is formed so that the width of face of the direction Y of a core of the honeycomb structure object 10 may become the same in the passage inlet-port end-face 16 direction.

[0082] Also with such a honeycomb structure object, the honeycomb structure object 10 and the same thermal stress reduction effectiveness as abbreviation which are shown in drawing 1 (a), (b), (c), and (d) can be demonstrated.

[0083] Drawing 3 (a) and (b) are the perspective views showing other examples of the honeycomb structure object concerning this invention.

[0084] The honeycomb structure object 10 shown in drawing 3 (a) is established including a part of part which the unsealed section 12 connects to the side face 13 of the honeycomb structure object 10 among planes of composition 22, and all of the parts linked to the passage outlet end face 14. Moreover, in this example, it is prepared so that the unsealed section 12 may connect continuously two points (A, B) of the end-face periphery section 15, and (C, D) and may cross in the center section of the passage outlet end face 14.

[0085] With such a honeycomb structure object 10, it has the advantage that the reduction effectiveness of the thermal stress in the passage outlet end face 14 is large.

[0086] A part of part where the unsealed section 12 connects further to the side face 13 of the honeycomb structure object 10 the honeycomb structure object 10 shown in drawing 3 (b) among planes of composition 22. It is prepared including all of the parts linked to the passage inlet-port end face 16, and it is prepared so that the end-face periphery section 17 may connect two points (not shown) continuously and the unsealed section 12 may cross in the center section of the passage inlet-port end face 16 like the passage outlet end face 14.

[0087] With such a honeycomb structure object 10, the reduction effectiveness of thermal stress is large at the passage outlet end face 14 and the passage inlet-port end face 16, and generating of a crack can be controlled further.

[0088] As for the honeycomb structure object 10 shown in drawing 4 (a), (b), (c), and (d), the joint material 25 is formed including all the parts that it is arranged in the core of the honeycomb structure object 10, and the unsealed section 12 connects to the side face 13 of the honeycomb structure object 10, the passage outlet end face 14, and the passage inlet-port end face 16 among planes of composition 22. As for drawing 4 (b), drawing 4 (a) shows the case where as for drawing 4 (c) the cross-section configuration of drawing 4 (d) of the joint material 25 is a rhombus when the cross-section configuration of the joint material 25 is a ball-race truck form, respectively, when the cross-section configuration of the joint material 25 is a rectangle, and the cross-section configuration of the joint material 25 is circular.

[0089] With such a honeycomb structure object 10, the reduction effectiveness of thermal stress is very large, and the ununiformity of temperature is large like a local elevated temperature or low temperature, and when the ununiformity is distributed covering the whole honeycomb structure object, it can consider as the honeycomb structure object which does not produce a crack etc.

[0090] On the other hand, it is prepared including a part of part which the honeycomb structure object 10 shown in drawing 5 (a), (b), (c), and (d) connects to all and the passage inlet-port end face 16 of the parts which the

unsealed section 12 connects to the side face 13 and the passage outlet end face 14 of the honeycomb structure object 10 among planes of composition 22, and a part of joint material 25 is exposed and formed in the passage inlet-port end face 16 of the honeycomb structure object 10.

[0091] Especially with this honeycomb structure object, it has the advantage that the effectiveness of reducing the thermal stress in the passage outlet end face 14 and a side face 13 is large.

[0092] The honeycomb structure object 10 shown in drawing 6 (a), (b), and drawing 7 (a) and (b) Like the honeycomb structure object 10 shown in drawing 4 (a), (b), (c), and (d) The unsealed section 12 is formed including all the parts linked to the side face 13, the passage outlet end face 14, and the passage inlet-port end face 16 of the honeycomb structure object 10 of a plane of composition 22, and many planes of composition 22 are further established by joining and constituting nine honeycomb members 14.

[0093] The honeycomb structure object 10 which the honeycomb structure object 10 shown in drawing 6 (a) and (b) shows the case where the cross-section configuration of the joint material 25 is a rectangle, like drawing 4 (a), and is shown in drawing 7 (a) and (b) shows the case where the cross-section configuration of the joint material 25 is an ellipse form.

[0094] With this honeycomb structure object 10, since the unsealed section 12 can be formed into the honeycomb structure object 10 at a large number and homogeneity in addition to the effectiveness which the honeycomb structure object 10 shown in drawing 4 (a) - (d) described by the way, the thermal stress of the honeycomb structure object 10 can be reduced extremely.

[0095] The honeycomb structure object 10 shown in drawing 8 (a) and (b) Like the honeycomb structure object 10 shown in drawing 4 (a), (b), (c), and (d) Join four honeycomb members 21 by the joint material 25, and the joint material 25 is arranged in the core of the honeycomb structure object 10. The unsealed section 12 is formed including all the parts linked to the side face 13, the passage outlet end face 14, and the passage inlet-port end face 16 of the honeycomb structure object 10 of a plane of composition 22. Moreover, with this honeycomb structure object 10, the restoration member 24 is arranged in a part of unsealed section 12 so that it may expose to the perimeter of the joint material 25 in a part of side face 13. The non-filling section 31 which the restoration member 24 is not arranged but forms the opening is formed including a part of part which connects with a part of side face 13 of the honeycomb structure object 10 among planes of composition 22, and all of the parts linked to the passage outlet end face 14 and the passage inlet-port end face 16.

[0096] With this honeycomb structure object 10, since the non-filling section 31 is formed in all of the parts linked to the passage outlet end face 14 and the passage inlet-port end face 16 while a fluid cannot flow the unsealed section 12 in the direction of passage and can prevent the blow by of a fluid by existence of the restoration member 24, it has the advantage that the reduction effectiveness of thermal stress is very large.

[0097] Honeycomb structure object 10 shown in drawing 9 (a) and (b) Everything but establishing many planes of composition 22 is taken as the same configuration as the honeycomb structure object 10 shown in drawing 8 (a) and (b) by joining and constituting nine honeycomb members 14 like the honeycomb structure object 10 shown in drawing 6 (a) and (b).

[0098] With this honeycomb structure object 10, since the unsealed section 12 can be formed into the honeycomb structure object 10 at a large number and homogeneity in addition to the effectiveness which the honeycomb structure object 10 shown in drawing 8 (a) and (b) described by the way, the thermal stress of the honeycomb structure object 10 can be reduced extremely.

[0099] Drawing 10 (a), (b), and (c) show the operation gestalt in the case of using as a honeycomb filter. In the honeycomb filter 1 shown in drawing 10 (a), (b), and (c) Like the honeycomb structure object 10 shown in drawing 4 (a), (b), (c), and (d) Four honeycomb filter members 33 are joined by the joint material 25. The joint material 25 is arranged in the core of a honeycomb filter 1, and the unsealed section 12 is formed including all the parts linked to the side face 13, the passage outlet end face 14, and the passage inlet-port end face 16 of a honeycomb filter 1 of a plane of composition 22. Moreover, it exposes between the restoration member 24 which is arranged in a part of unsealed section 12 so that all the parts from which the opening formed of the unsealed section 12 exposes the restoration member 24 to the passage inlet-port end face 16 in this honeycomb filter 1 may be blockaded, and was arranged in the passage inlet-port end-face 16 side, and the joint material 25, and to the passage outlet end face 14, and the non-filling section 31 which a filler is not arranged but forms the opening is formed.

[0100] In this honeycomb filter 1, since the opening is formed near the passage outlet end face 14 and the

passage inlet-port end face 16, without the soot in exhaust gas accumulating on the non-filling section 31 by the side of a gas inflow while being able to use suitably as a honeycomb filter, it has the advantage that the reduction effectiveness of thermal stress is very large.

[0101] Next, although the example of the manufacture approach of the honeycomb structure object and honeycomb filter concerning this invention is explained, this invention is not limited to these.

[0102] (Example 1 of manufacture) As a raw material, the mixed powder of 75 % of the weight of SiC powder and 25 % of the weight of metal Si powder was used, methyl cellulose and hydroxypropoxyl methyl cellulose, a surfactant, and water were added to this, and the reversible plastic matter was produced.

[0103] Subsequently, extrusion molding of this plastic matter is carried out, it has the configuration from which the cross-section configurations of shaft orientations and a perpendicular direction which cut the shape of a cylindrical shape comparatively at fixed spacing to shaft orientations for 9 minutes, and are acquired differ [ rectangular head / a sector ], respectively, and 0.3mm and a cel consistency produced [ the thickness of a septum ] two or more honeycomb objects of 31 cels / cm<sup>2</sup>.

[0104] Subsequently, it dried, after assembling to one by forming the junctional zone of the same presentation as a plastic matter in a part for the abbreviation center section of an parallel field substantially after desiccation by microwave and hot blast with the direction of passage of a negotiation hole [ in / for the honeycomb object of these plurality / a honeycomb object ], and joining each of this honeycomb object through this junctional zone after that. It degreased at about 400 degrees C among N<sub>2</sub> ambient atmosphere, and the desiccation object after the acquired assembly was calcinated at about 1550 degrees C in inert atmospheres, such as Ar, after that. The dimension was able to produce the honeycomb structure object shown in 144mmphix152mmL and drawing 9 whose clearance between joints is 2mm by filling up width of face of 5-10mm with the filler which contains for example, the nature fiber of aluminosilicate, SiC powder, metal Si complications, an organic binder, an inorganic binder, and water in the periphery section of the unsealed section after baking, and drying at about 100 degrees C.

[0105] In the example 1 of manufacture, fabricate the honeycomb object of the prism configuration whose end-face configuration is 50mmx50mm, and after joining two or more honeycomb objects and unifying, calcinate and the appearance of the acquired honeycomb structure object is processed. (Example 2 of manufacture) The dimension was able to produce the honeycomb structure object shown in drawing 9 like the example 1 of manufacture except having produced the honeycomb structure object having considered as the shape of a cylindrical shape of 144mmphix152mmL, and by applying a periphery and subsequently, calcinating the same plastic matter as a junctional zone.

[0106] Like the example 1 of manufacture, fabricate the honeycomb object of the prism configuration whose end-face configuration is 50mmx50mm, and after joining two or more honeycomb objects and unifying, calcinate and the appearance of the acquired honeycomb structure object is processed. (Example 3 of manufacture) Subsequently the dimension was able to produce the honeycomb structure object shown in drawing 9 like the example 1 of manufacture except having produced the honeycomb structure object having considered as the shape of a cylindrical shape of 144mmphix152mmL, and by applying a periphery and drying with a filler.

[0107] (Example 4 of manufacture) The honeycomb filter was able to be manufactured by the same above-mentioned approach as the examples 1-3 of manufacture except performing the process which \*\*\*\*\* the ends side of honeycomb member passage alternately.

[0108]

[Example] Hereafter, although this invention is further explained to a detail based on a concrete example, this invention is not limited to these examples.

[0109] By the example 1 of example 1 manufacture, the dimension produced the diesel-power-plant exhaust air clarification party curate honeycomb filter which \*\*\*\*\* (ed) alternately 144mmphix152mmL and the negotiation hole of a large number which 0.3mm and a cel consistency penetrate [ the thickness of a septum ] to the passage inlet-port end face and passage outlet end face of the honeycomb object made from SiC of 31 cels / cm<sup>2</sup> by the passage inlet-port end face and passage outlet end face which a negotiation hole penetrates.

Moreover, in this honeycomb filter, as shown in drawing 1 (a), a part of part which connects the unsealed section 12 to the passage outlet end face (upper bed side) 14 and a side face 13 among planes of composition 22 is included. From the side face 13, it has prepared aslant so that the width of face of the direction Y of a core of

the honeycomb structure object 10 may become small gradually in the passage inlet-port end-face 16 direction. The die length of the unsealed section 12 was set to 50mm in the direction of passage of the honeycomb structure object 10 in the direction of a core of 30mm and the passage outlet end-face (upper bed side) periphery section 15 to the honeycomb structure object 10 from the passage outlet end-face (upper bed side) periphery section 15.

[0110] In examples 2-6 and ten examples 1, respectively Drawing 1 (d), drawing 3 (a), having considered as the structure of having drawing 3 (b), drawing 4 (a), drawing 4 (b), and the unsealed section shown in drawing 7 -- and When the opening formed between the unsealed sections 12 of the honeycomb structure object 10 was exposed and formed in the passage inlet-port end face (soffit side) 16, the same thing as an example 1 was produced except having arranged the restoration member 25 of the property which shows the part to expose in a table 1 so that it may blockade in a depth of 6mm.

[0111] In addition, a Young's modulus ratio is a ratio of the Young's modulus of a filler to the Young's modulus of a honeycomb member among a table 1, and measurement calculation was carried out from the relation between a load and the amount of displacement by the static-modulus examining method about each Young's modulus. Moreover, reinforcement meant the material strength of the filler to a honeycomb member, and it measured by the four-point bending test (JIS1601) using the material testing machine about each material strength. Moreover, the case where the direction of a filler had large reinforcement was indicated to be "size", and the case of being small was indicated to be "smallness."

[0112] In seven to example 9 example 6, the same thing as an example 6 was produced except having used the thing of the Young's modulus ratio which shows a filler in a table 1, and reinforcement.

[0113] In example 11 example 1, the same thing as an example 1 was produced except having formed the unsealed section 12 by die length of 5mm in the direction of passage of die length of 15mm, and the passage outlet end-face (upper bed side) periphery section 15 to the honeycomb structure object 10 in the direction of a core of the passage outlet end-face (upper bed side) periphery section 15 to the honeycomb structure object 10.

[0114] While making it the structure shown in drawing 3 (a) in an example 12 and 13 examples 1 The same thing as an example 1 was produced except the established thing which formed the unsealed section 12 by die length of 15 or 5mm in the direction of a core of die length of 15 or 5mm, and the upper bed side periphery section 15 to the honeycomb structure object 10 in the direction of passage of the up end-face periphery section 15 to the honeycomb structure object 10, respectively.

[0115] The same thing as an example 1 was created except having created the thing of integral construction which does not have the example of comparison 1 unsealed section.

[0116] The mat non-expanded made from a ceramic is wound around the side face 13 of the honeycomb structure object (honeycomb filter) 10 as grasping material. (Assessment) After pushing into the can for cannings made from SUS409 and considering as the canning structure, By making the combustion gas containing the soot generated by combustion of diesel fuel gas oil flow from the soffit side 16 of the honeycomb structure object (honeycomb filter) 10, and making it flow out from the upper bed side 14 Once carrying out uptake of the soot into the honeycomb structure object (honeycomb filter) 10 and then cooling radiationally to a room temperature, By making the combustion gas which contains the oxygen of a fixed rate at 800 degrees C from the soffit side 16 of the honeycomb structure object (honeycomb filter) 10 flow, the filter playback trial which carries out combustion clearance of the soot was carried out.

[0117] In the honeycomb filter of examples 1-10 and the example 1 of a comparison the transition duration which raises inlet gas temperature from a room temperature to 800 degrees C, and uptake soot weight -- three kinds (transition duration: -- standard conditions (300 seconds) -- the \*\* (240 seconds) shortest (180 seconds) (uptake soot weight: -- standard conditions (10g/L) -- Size (14g/L) and when examining by carrying out the maximum (18 g/L) setting out, the existence of generating of the crack in each part of the upper bed side (outlet) of a honeycomb structure object, a soffit side (inlet port), a periphery, and the interior was investigated.

[0118] On the other hand, in the honeycomb filter of examples 1, 11-13, uptake soot weight was quantitatively set up by six kinds of 10 g/L - 20 g/L (transition duration: standard conditions), and the filter playback trial was carried out like \*\*\*\*. A result is collectively shown in tables 1 and 2. In addition, about generating of a crack, O showed what was not generated at all and \*\* showed what was generated.

[0119]

[A table 1]

構造	捕集すす量 過渡時間 クラック調査部位 充填材 ヤング率比	最大		大		標準		
		最短		短		標準		
		入口	出口	内部	外周	入口	出口	内部
								外周
実施例1	図1(a)	80%	小	△	△	△	△	○
実施例2	図1(d)	80%	小	△	△	△	○	○
実施例3	図3(e)	80%	小	△	○	△	△	○
実施例4	図3(b)	80%	小	○	○	△	○	○
実施例5	図4(e)	80%	小	○	○	△	○	○
実施例6	図4(b)	80%	小	○	○	△	○	○
実施例7	図4(b)	83%	小	○	○	△	○	○
実施例8	図4(b)	80%	大	○	○	△	△	○
実施例9	図4(b)	85%	大	○	△	△	○	○
実施例10	図7	80%	小	○	○	○	○	○
比較例1	未接合部無し	80%	小	△	△	△	△	○

[0120]

[A table 2]

		実施例1	実施例11	実施例12	実施例13
構造	図1(a)	図1(a)	図3(a)	図3(a)	
未接合部	中心方向長さ	50mm	15mm	15mm	5mm
	流路方向長さ	30mm	5mm	15mm	5mm
ハニカム構造体	直径	144mm	144mm	144mm	144mm
	全長	152mm	152mm	152mm	152mm
捕集すす量 (g/L)	10	○	○	○	○
	12	○	○	○	△
	14	○	△	○	△
	16	○	△	○	△
	18	○	△	○	△
	20	○	△	△	△

[0121] As shown in a table 1, even if it was the case of standard conditions, in the honeycomb structure object of the example 1 of a comparison of unsealed-section-less structure, there was no generating of a crack at the honeycomb filter ( drawing 1 (a), drawing 1 (d), drawing 3 (a), drawing 3 (b), drawing 4 (a), drawing 4 (b), drawing 7 ) of examples 1-10 to generating of a crack being accepted in the end face of an inlet port and an outlet.

[0122] In addition, although generating of a crack might arise in part when a transition duration is shortened, uptake soot weight was made to increase, the ununiformity of temperature became large and the unsealed section was formed only near the end side of the periphery section of a honeycomb filter like drawing 1 (a) and drawing 3 (a). The side face of a honeycomb filter [ in / like drawing 4 (b) / in the unsealed section / a plane of composition ], In the honeycomb filter prepared including all the parts linked to a passage outlet end face and a passage inlet-port end face, a crack was hardly generated, and generating of a crack was not further accepted at all in an increase or the example carried out in the number of planes of composition like drawing 7 . Moreover, the Young's modulus of a filler was 80% or less of the Young's modulus of a honeycomb member, or when the material strength of a filler was smaller than the honeycomb member, there was little generating of a crack.

[0123] Moreover, as shown in a table 2, the inclination for the rate which a crack will generate according to buildup of the amount of soot if the direction of passage of the upper bed side periphery section 15 to the honeycomb structure object 10 of an unsealed part and main lay length become shorter than predetermined to increase was accepted.

[0124]

[Effect of the Invention] Since each part of a honeycomb structure object and a honeycomb filter can deform freely according to the honeycomb structure object and honeycomb filter of this invention, without being restrained mutually even if the ununiformity of temperature distribution arises as explained above, thermal stress can be reduced, consequently the effectiveness that generating of a crack can be prevented is done so.

[Translation done.]

## \* NOTICES \*

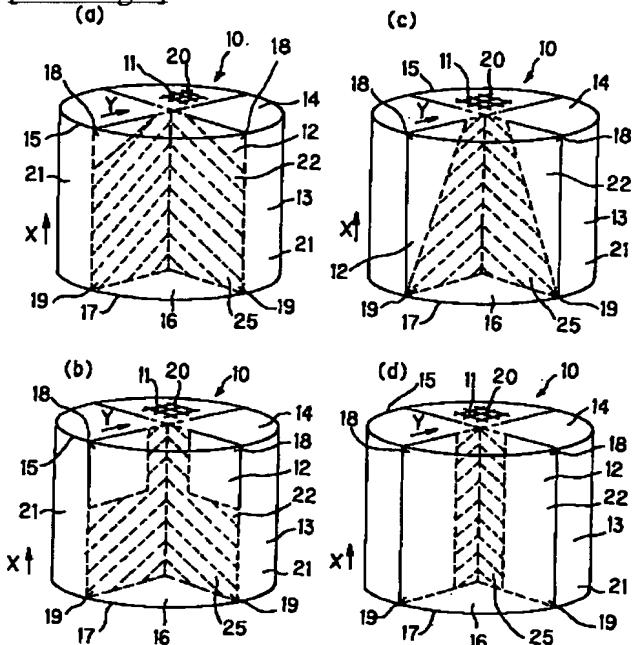
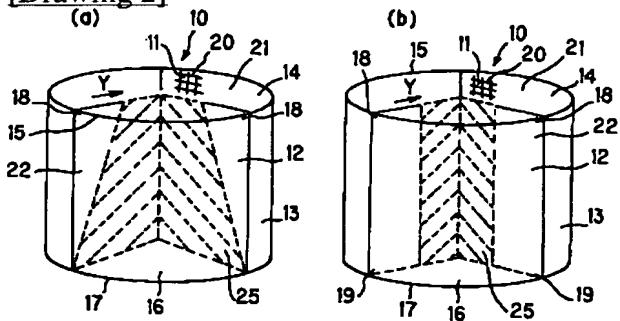
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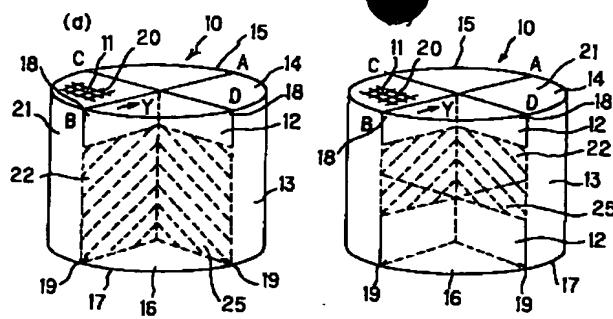
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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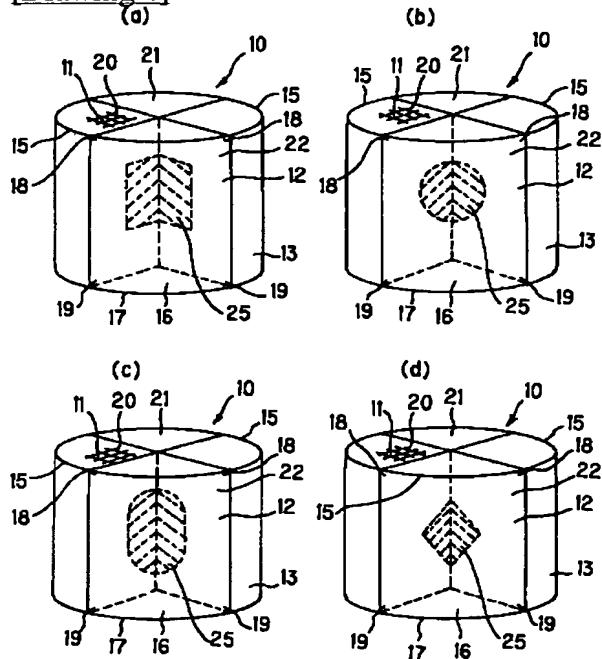
**DRAWINGS**

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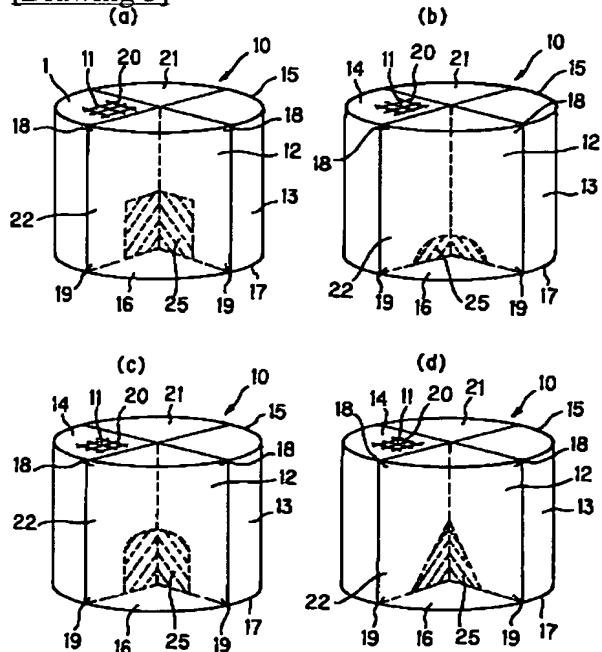
**[Drawing 1]****[Drawing 2]****[Drawing 3]**

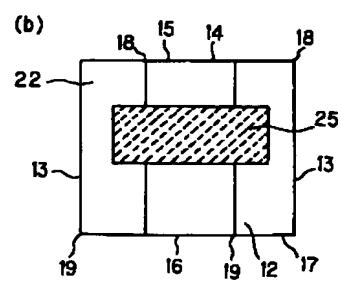
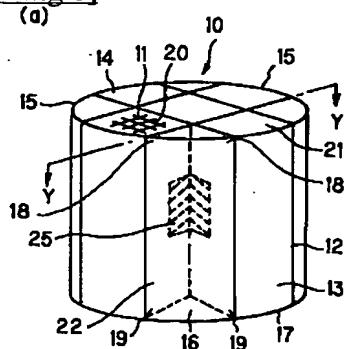
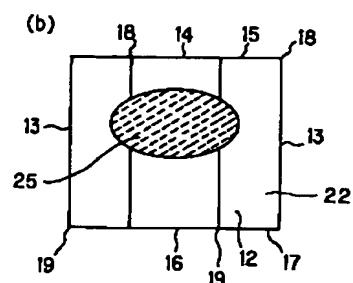
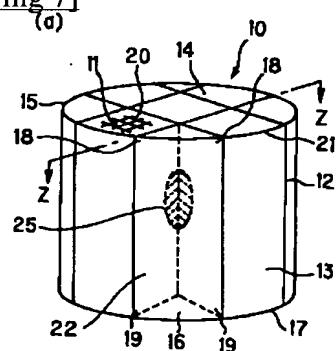


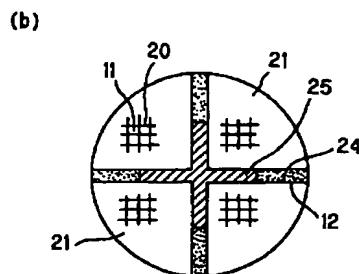
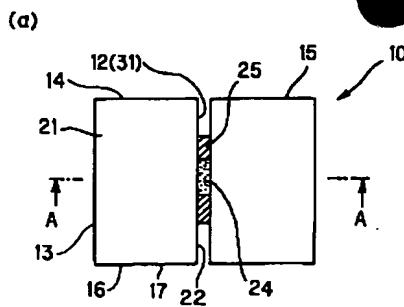
### [Drawing 4]



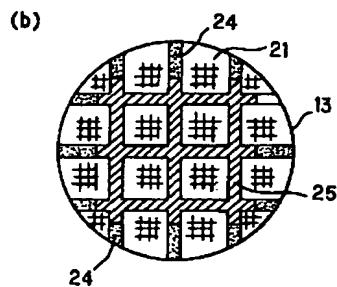
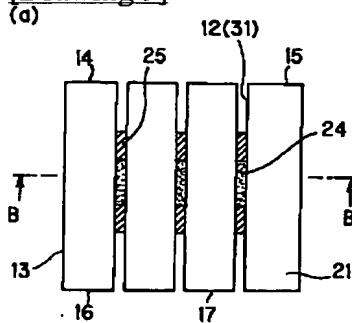
[Drawing 5]



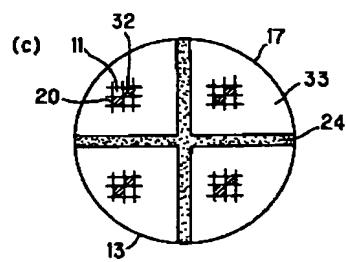
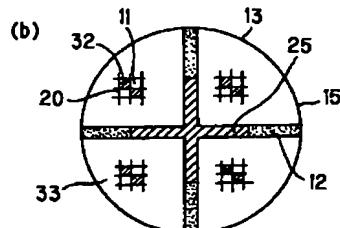
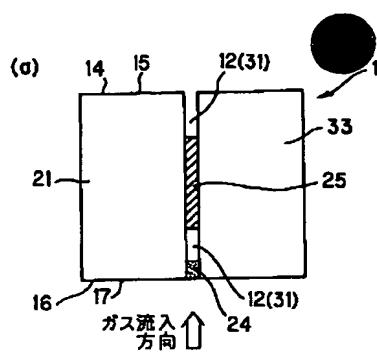
[Drawing 6][Drawing 7][Drawing 8]



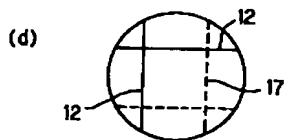
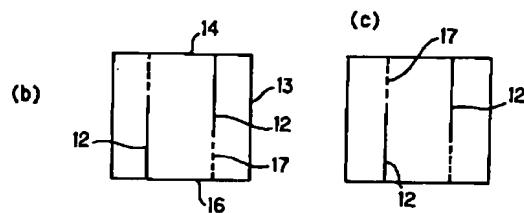
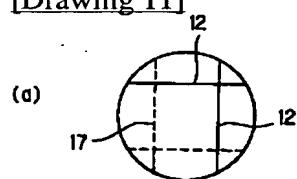
[Drawing 9]



[Drawing 10]



[Drawing 11]




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[Translation done.]

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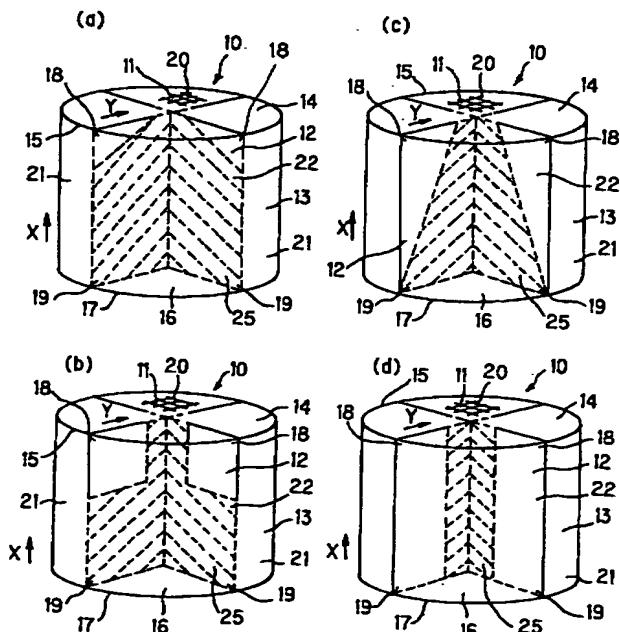
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(54) 【発明の名称】ハニカム構造体とハニカムフィルター、及びそれらの製造方法

(57) 【要約】

【課題】 使用時における熱応力によるクラック発生が生じない耐久性に優れたハニカム構造体等、及びそれらの製造方法を提供する。

【解決手段】 隔壁20により仕切られた多数の流通孔11を有するハニカム部材21を複数備え、この複数のハニカム部材21が、ハニカム部材21と実質的に同材質の接合部材25により、流通孔の流路方向と実質的に平行な面(接合面)22で接合され、複数のハニカム部材21が一体化されてなるハニカム構造体である。ハニカム部材21における接合面22が、少なくとも、流路入口端面外周部15及び/又は流路出口端面外周部17に接続する端部を含んで、未接合部12を有する構造とする。



## 【特許請求の範囲】

【請求項1】 隔壁により仕切られた多数の流通孔を有するハニカム部材を複数備え、該複数のハニカム部材が、該ハニカム部材と実質的に同材質の接合部材により、該流通孔の流路方向と実質的に平行な面で接合され、該複数のハニカム部材が一体化されてなるハニカム構造体であって、

該ハニカム部材における接合面が、少なくとも、流路入口端面外周部及び／又は流路出口端面外周部に接続する端部を含んで、未接合部を有することを特徴とするハニカム構造体。

【請求項2】 隔壁により仕切られた多数の流通孔を有するハニカム部材を複数有し、該複数のハニカム部材を、該流通孔の流路方向と実質的に平行な面で接合部材により接合して一体化してなるハニカム構造体であって、

該ハニカム部材が、金属SiとSiCとを主成分とし、 $Si / (Si + SiC)$ で規定されるSi含有量が5～50重量%であり、

該接合部材が、金属SiとSiCとを主成分とし、 $Si / (Si + SiC)$ で規定されるSi含有量が、接合される該ハニカム部材と同等かそれより多く、かつ10～80重量%であり、

該ハニカム部材における接合面が、少なくとも、流路入口端面外周部及び／又は流路出口端面外周部に接続する端部を含んで、未接合部を有することを特徴とするハニカム構造体。

【請求項3】 該接合部材が、該接合面に、連続的に配設されていることを特徴とする請求項1又は2に記載のハニカム構造体。

【請求項4】 該接合面の該未接合部が、該流路入口端面外周部又は流路出口端面外周部から該流通孔の流路方向に、同方向における該ハニカム構造体の全長に対し、10%以上の長さで設けられていることを特徴とする請求項1～3のいずれか一項に記載のハニカム構造体。

【請求項5】 該接合面の該未接合部が、該流路入口端面外周部又は該流路出口端面外周部から各端面の中心方向に、同方向における該ハニカム構造体の全幅に対し、10%以上の長さで設けられていることを特徴とする請求項1～4のいずれか一項に記載のハニカム構造体。

【請求項6】 該接合面の該未接合部の少なくとも一部に、耐熱無機材料を主成分とする充填部材が配設されていることを特徴とする請求項1～5のいずれか一項に記載のハニカム構造体。

【請求項7】 該充填部材のヤング率が、ハニカム部材のヤング率の80%以下であること、又は該充填部材の材料強度が、該ハニカム部材の材料強度より小さいこと、の少なくともいずれか一方を満足することを特徴とする請求項6に記載のハニカム構造体。

【請求項8】 該ハニカム部材の主成分が、コージェラ

イト、ムライト、アルミナ、スピネル、炭化珪素、窒化珪素、リチウムアルミニウムシリケート、チタン酸アルミニウム及びこれらの組み合わせよりなる群から選ばれる少なくとも1種のセラミックス、又はFe-Cr-A1系金属である請求項1、3～7のいずれか一項に記載のハニカム構造体。

【請求項9】 該ハニカム部材の隔壁上に触媒が担持されていることを特徴とする請求項1～8のいずれか一項に記載のハニカム構造体。

10 【請求項10】 隔壁により仕切られ、流路入口端面及び流路出口端面に貫通する多数の流通孔を、該流通孔が貫通する該流路入口端面及び流路出口端面で互い違いに目封じされているハニカムフィルター部材を複数有し、該ハニカムフィルター部材を、該流通孔の流路方向と平行な面で、該ハニカムフィルター部材と実質的に同材質の接合部材により接合して、一体化してなるハニカムフィルターであって、

該ハニカムフィルター部材における接合面が、少なくとも、流路入口端面外周部又は流路出口端面外周部に接続する端部を含んで、未接合部を有することを特徴とするハニカムフィルター。

【請求項11】 隔壁により仕切られ、流路入口端面及び流路出口端面に貫通する多数の流通孔を、該流通孔が貫通する該流路入口端面及び流路出口端面で互い違いに目封じされているハニカムフィルター部材を複数有し、該複数のハニカムフィルター部材を、該流通孔の流路方向と平行な面で、接合部材により接合、一体化してなるハニカムフィルターであって、

該ハニカムフィルター部材の基体が、金属SiとSiCとを主成分とし、 $Si / (Si + SiC)$ で規定されるSi含有量が5～50重量%であり、

該接合部材が、金属SiとSiCとを主成分とし、 $Si / (Si + SiC)$ で規定されるSi含有量が、接合される該ハニカムフィルター部材の基体と同等かそれより多く、かつ10～80重量%であり、

該ハニカムフィルター部材における接合面が、少なくとも、流路入口端面外周部及び／又は流路出口端面外周部に接続する端部を含んで、未接合部を有することを特徴とするハニカムフィルター。

40 【請求項12】 該接合部材が、該接合面に、連続的に配設されていることを特徴とする請求項10又は11に記載のハニカムフィルター。

【請求項13】 該接合面の該未接合部が、該流路入口端面外周部又は該流路出口端面外周部から該流通孔の流路方向に、同方向における該ハニカムフィルターの全長に対し、10%以上の長さで設けられていることを特徴とする請求項10～12のいずれか一項に記載のハニカムフィルター。

【請求項14】 該接合面の該未接合部が、該流路入口端面外周部又は該流路出口端面外周部から各端面の中心

方向に、同方向における該ハニカムフィルターの全幅に対し、10%以上の長さで設けられていることを特徴とする請求項10～13のいずれか一項に記載のハニカムフィルター。

【請求項15】 該接合面の該未接合部の少なくとも一部に、耐熱無機材料を主成分とする充填部材が配設していることを特徴とする請求項10～14のいずれか一項に記載のハニカムフィルター。

【請求項16】 該充填部材のヤング率が、ハニカム部材のヤング率の80%以下であること、又は該充填部材の材料強度が、該ハニカム部材の材料強度より小さいこと、の少なくともいずれか一方を満足することを特徴とする請求項15に記載のハニカムフィルター。

【請求項17】 該ハニカムフィルター部材の主成分が、コーチェライト、ムライト、アルミナ、スピネル、炭化珪素、窒化珪素、リチウムアルミニウムシリケート、チタン酸アルミニウム及びこれらの組み合わせによる群から選ばれる少なくとも1種のセラミックス、又はFe-Cr-Al系金属である請求項10、12～16のいずれか一項に記載のハニカムフィルター。

【請求項18】 該ハニカム部材の隔壁上に触媒が担持されていることを特徴とする請求項10～17のいずれか一項に記載のハニカムフィルター。

【請求項19】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体を得、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム体を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカム構造体の製造方法。

【請求項20】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、該ハニカム体を焼成してハニカム部材を得、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカム部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム部材を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカム構造体の製造方法。

【請求項21】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、該ハニカム体の外形を加工し、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム体を、該接合層を介して接合して一体化した後、焼

成することを特徴とするハニカム構造体の製造方法。

【請求項22】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体を得、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム体を、該接合層を介して接合して一体化した後、外形を加工し、その後焼成することを特徴とするハニカム構造体の製造方法。

【請求項23】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、該ハニカム体の外形を加工した後、焼成してハニカム部材を得、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカム部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム部材を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカム構造体の製造方法。

【請求項24】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とし、次いで、該ハニカム体を焼成してハニカム部材とした後、該ハニカム部材の外形を加工し、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカム部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム部材を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカム構造体の製造方法。

【請求項25】 該接合層を、連続的に形成することを特徴とする請求項19～24のいずれか一項に記載のハニカム構造体の製造方法。

【請求項26】 請求項19～25のいずれか一項に記載の方法で得られたハニカム構造体の外形を、更に加工することを特徴とするハニカム構造体の製造方法。

【請求項27】 請求項19～26のいずれか一項に記載の製造方法で得られるハニカム構造体の側面の少なくとも一部に、耐熱無機材料を主成分とする充填材を塗布することを特徴とするハニカム構造体の製造方法。

【請求項28】 該接合層を一部に形成した面のうち、接合層が形成されていない部分の少なくとも一部に、耐熱無機材料を主成分とする充填材を配設することを特徴とする請求項19～27のいずれか一項に記載のハニカム構造体の製造方法。

【請求項29】 該ハニカム体及び該接合層の主成分が、コーチェライト、ムライト、アルミナ、スピネル、炭化珪素、窒化珪素、リチウムアルミニウムシリケート、チタン酸アルミニウム及びこれらの組み合わせによる群から選ばれる少なくとも1種のセラミックス、F

e-Cr-Al系金属、又は金属SiとSiCからなることを特徴とする請求項19～28のいずれか一項に記載のハニカム構造体の製造方法。

【請求項30】 請求項19～29のいずれか一項に記載の製造方法によりハニカム構造体を製造後、触媒を担持することを特徴とする触媒付きハニカム構造体の製造方法。

【請求項31】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体を得、次いで、該ハニカム体の流路入口端面及び流路出口端面に貫通する多数の流通孔を、該流路入口端面及び該流路出口端面で互い違いに目封じして目封じハニカム体を作製し、次いで、該ハニカム体と実質的に同材質からなる接合層を、該目封じハニカム体における該流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該目封じハニカム体を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法。

【請求項32】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、該ハニカム体を焼成してハニカム部材を得、次いで、該ハニカム部材の、流路入口端面及び流路出口端面に貫通する多数の流通孔を、該流路入口端面及び該流路出口端面で互い違いに目封じしてハニカムフィルタ一部材を作製し、次いで、該ハニカム体と実質的に同材質からなる接合層を、該ハニカムフィルタ一部材における該流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカムフィルタ一部材を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法。

【請求項33】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体を得、次いで、該ハニカム体の流路入口端面及び流路出口端面に貫通する多数の流通孔を、該流路入口端面及び該流路出口端面で互い違いに目封じして目封じハニカム体を作製し、次いで、該ハニカム体と実質的に同材質の接合層を、該目封じハニカム体における該流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該目封じハニカム体を、該接合層を介して接合して一体化した後、外形を加工し、その後焼成することを特徴とするハニカムフィルターの製造方法。

【請求項34】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、該ハニカム体の外形を加工し、次いで、該ハニカム体の流路入口端面及び流路出口端面に貫通する多

数の流通孔を、該流路入口端面及び該流路出口端面で互い違いに目封じして目封じハニカム体を作製し、次いで、該ハニカム体と実質的に同材質の接合層を、該目封じハニカム体における該流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該目封じハニカム体を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法。

10 【請求項35】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、該ハニカム体の外形を加工した後、焼成してハニカム部材を得、次いで、該ハニカム部材の流路入口端面及び流路出口端面に貫通する多数の流通孔を、該流路入口端面及び該流路出口端面で互い違いに目封じしてハニカムフィルタ一部材を作製し、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカムフィルタ一部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカムフィルタ一部材を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法。

20 【請求項36】 原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、該ハニカム体を焼成してハニカム部材とした後、該ハニカム部材の外形を加工し、次いで、該ハニカム部材の流路入口端面及び流路出口端面に貫通する多数の流通孔を、該流路入口端面及び該流路出口端面で互い違いに目封じしてハニカムフィルタ一部材を作製し、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカムフィルタ一部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカムフィルタ一部材を、該接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法。

30 【請求項37】 該接合層を、連続的に形成することを特徴とする請求項31～36のいずれか一項に記載のハニカムフィルターの製造方法。

40 【請求項38】 請求項31～37のいずれか一項に記載の方法で得られたハニカムフィルターの外形を、更に加工することを特徴とするハニカムフィルターの製造方法。

【請求項39】 請求項31～38のいずれか一項に記載の製造方法で得られるハニカムフィルターの側面の少なくとも一部に、耐熱無機材料を主成分とする充填材を塗布することを特徴とするハニカムフィルターの製造方法。

50 【請求項40】 該接合層を一部に形成した面のうち、

接合層が形成されていない部分の少なくとも一部に、耐熱無機材料を主成分とする充填材を配設することを特徴とする請求項31～39のいずれか一項に記載のハニカムフィルターの製造方法。

【請求項41】 該ハニカム体及び該接合材の主成分が、コーチェライト、ムライト、アルミナ、スピネル、炭化珪素、窒化珪素、リチウムアルミニウムシリケート、チタン酸アルミニウム及びこれらの組み合わせによる群から選ばれる少なくとも1種のセラミックス、Fe-Cr-Al系金属、又は金属SiとSiCからなることを特徴とする請求項31～40のいずれか一項に記載のハニカムフィルターの製造方法。

【請求項42】 請求項31～41のいずれか一項に記載の製造方法によりハニカムフィルターを製造後、触媒を担持することを特徴とする触媒付きハニカムフィルターの製造方法。

#### 【発明の詳細な説明】

##### 【0001】

【発明の属する技術分野】 本発明は、内燃機関等の熱機関、又はボイラー等の燃焼装置の排気ガス浄化装置や、液体燃料又は気体燃料の改質装置等に用いられる触媒担持用のハニカム構造体とハニカムフィルター、及びそれらの製造方法に関する。

##### 【0002】

【従来の技術】 従来、内燃機関等の熱機関又はボイラ等の燃焼装置の排気ガス浄化装置や、液体燃料又は気体燃料の改質装置等に、触媒成分を担持したハニカム構造体が用いられている。また、ディーゼルエンジンから排出される排気ガスのような含塵流体中に含まれる粒子状物質を捕集除去するために、ハニカムフィルターを用いることが知られている。

【0003】 このような目的で使用されるハニカム構造体又はハニカムフィルターは、排気ガスの急激な温度変化や局所的な発熱にさらされて内部に不均一な温度分布が生じやすく、それが原因でクラックが発生する等の問題があった。特に、ディーゼルエンジンの排気中の粒子状物質を捕集するハニカムフィルターとして用いられる場合には、溜まったカーボン微粒子を燃焼させて除去することが必要であり、この際に局所的な高温化が避けられないため、大きな熱応力が発生し易く、クラックが発生し易かった。ここで、熱応力の発生は、温度分布の不均一により、ハニカム構造体各部の熱膨張変形が異なるのに対し、各部が互いに拘束されて自由に変形できないことによるものである。

【0004】 また、使用目的によりハニカム構造体が大型化する場合には、複数のハニカム部材を接合部材により接合して一体化したハニカム構造体又はハニカムフィルターを作成することが知られており、この場合も、発生する熱応力を低減させる工夫が必要となる。

【0005】 热応力を低減する方策として、従来、例

えば、U.S.P.4335783号公報には、多数のハニカム部材を不連続な接合部材で接合するハニカム構造体の製造方法が開示されている。しかし、このハニカム構造体では、熱応力が、主に流通孔が貫通する両端面外周部近傍に発生するということが考慮されていないため、熱応力を必ずしも充分に緩和するものではなかった。また、接合部材が、不連続に設けられているため、ハニカム部材の接合強度が充分ではなく、得られるハニカム構造体の機械的強度が必ずしも充分なものではなかった。

【0006】 また、特公昭61-51240号公報には、セラミック材料よりなるハニカム構造のマトリックス部材を押し出し成形し、焼成後その外周部を加工して平滑にした後、その接合部に焼成後の鉱物組成がマトリックス部材と実質的に同一で、かつ熱膨脹率の差が800°Cにおいて0.1%以下となるセラミック接合材を塗布し、焼成する耐熱衝撃性回転蓄熱体が提案されている。しかしながら、この耐熱衝撃性回転蓄熱体でも、熱応力が、主に流路入口端面及び流路出口端面の外周部近傍に発生するにもかかわらず、ハニカム部材がこれら両端面外周部で接合されているため、熱応力を必ずしも充分に緩和するものではなかった。

【0007】 また、1986年のSAE論文860008には、コーチェライトのハニカム部材を同じくコーチェライトセメントで接合したセラミックハニカムフィルターが開示されている。しかしながら、このハニカムフィルターでも、流路入口端面外周部及び出口端面外周部まで接合されている点で、前述のハニカム構造体等と同様であり、やはり熱応力を必ずしも充分に緩和するものではなかった。

【0008】 さらに、特開平8-28246号公報には、複数のハニカムセラミック部材を、少なくとも三次元的に交錯する無機纖維と無機粒子とを、無機バインダー、及び有機バインダーを介して相互に結合してなる弾性質シール部材で接着したセラミックハニカムフィルターが開示されている。しかし、このハニカムフィルターでも、ハニカム部材とシール部材が同材質でなく、また、流路入口端面外周部及び出口端面外周部まで接着されているため、その端面に発生する熱応力を緩和できないという問題点があった。

##### 【0009】

【発明が解決しようとする課題】 本発明は、このような従来の課題に鑑みてなされたものであり、その目的とするところは、使用時における熱応力によるクラック発生が生じない耐久性に優れたハニカム構造体、ハニカムフィルター、及びそれらの製造方法を提供することにある。

##### 【0010】

【課題を解決するための手段】 本発明によれば、隔壁により仕切られた多数の流通孔を有するハニカム部材を複数備え、この複数のハニカム部材が、ハニカム部材と

実質的に同材質の接合部材により、流通孔の流路方向と実質的に平行な面で接合され、該複数のハニカム部材が一体化されてなるハニカム構造体であって、ハニカム部材における接合面が、少なくとも、流路入口端面外周部及び／又は流路出口端面外周部に接続する端部を含んで、未接合部を有することを特徴とするハニカム構造体が提供される。

【0011】また、本発明によれば、隔壁により仕切られ、流路入口端面及び流路出口端面に貫通する多数の流通孔を、流通孔が貫通する流路入口端面及び流路出口端面で互い違いに目封じされているハニカムフィルター部材を複数有し、このハニカムフィルター部材が、該ハニカムフィルター部材と実質的に同材質の接合部材により、該流通孔の流路方向と平行な面が接合され、該複数のハニカム部材が一体化されてなるハニカムフィルターであって、このハニカムフィルター部材における接合面が、少なくとも、流路入口端面外周部又は流路出口端面外周部に接続する端部を含んで、未接合部を有することを特徴とするハニカムフィルターが提供される。

【0012】これらハニカム構造体及びハニカムフィルター（以下、「ハニカム構造体等」と省略していることがある。）においては、ハニカム部材及び接合部材の主成分が金属SiとSiCからなり、ハニカム部材のSi/(Si+SiC)で規定されるSi含有量が5～50重量%であり、接合部材のSi/(Si+SiC)で規定されるSi含有量が、接合されるハニカム部材と同等かそれより多く、かつ10～80重量%であるものとすることもできる。

【0013】また、本発明のハニカム構造体等においては、接合部材が、接合面に、連続的に配設されていることが好ましく、接合面の未接合部が、流路入口端面外周部又は流路出口端面外周部から流通孔の流路方向に、同方向におけるハニカム構造体の全長に対し、10%以上の長さで設けられていること、又は流路入口端面外周部又は流路出口端面外周部から各端面の中心方向に、同方向におけるハニカム構造体の全幅に対し、10%以上の長さで設けられていることが好ましい。

【0014】さらに、本発明のハニカム構造体等においては、接合面の未接合部の少なくとも一部に、耐熱無機材料を主成分とする充填部材が配設されていることが好ましく、この際、充填部材のヤング率が、ハニカム部材のヤング率の80%以下であること、又は充填部材の材料強度が、ハニカム部材の材料強度より小さいこと、の少なくともいずれか一方を満足することが好ましい。

【0015】さらにまた、本発明のハニカム構造体等においては、ハニカム部材の主成分が、コーチェライト、ムライト、アルミナ、スピネル、炭化珪素、窒化珪素、リチウムアルミニウムシリケート、チタン酸アルミニウム及びこれらの組み合わせによる群から選ばれる少なくとも1種のセラミックス、又はFe-Cr-Al

系金属であることが好ましい。また、ハニカム部材の隔壁上に、触媒を担持させることもできる。

【0016】他方、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体を得、次いで、ハニカム体と実質的に同材質の接合層を、ハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数のハニカム体を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカム構造体の製造方法が提供される。

【0017】また、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、ハニカム体を焼成してハニカム部材を得、次いで、ハニカム体と実質的に同材質の接合層を、ハニカム部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数のハニカム部材を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカム構造体の製造方法が提供される。

【0018】さらに、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、ハニカム体の外形を加工し、次いで、ハニカム体と実質的に同材質の接合層を、ハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム体を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカム構造体の製造方法が提供される。

【0019】さらにもた、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体を得、次いで、該ハニカム体と実質的に同材質の接合層を、該ハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム体を、該接合層を介して接合して一体化した後、外形を加工し、その後焼成することを特徴とするハニカム構造体の製造方法が提供される。

【0020】さらにもた、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、ハニカム体の外形を加工した後、焼成してハニカム部材を得、次いで、ハニカム体と実質的に同材質の接合層を、ハニカム部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数のハニカム部材を、接合層を介して接合して一体化した

後、焼成することを特徴とするハニカム構造体の製造方法が提供される。

**【0021】** さらにまた、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とし、次いで、ハニカム体を焼成してハニカム部材とした後、ハニカム部材の外形を加工し、次いで、ハニカム体と実質的に同材質の接合層を、ハニカム部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の該ハニカム部材を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカム構造体の製造方法が提供される。

**【0022】** 他方、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体を得、次いで、ハニカム体の流路入口端面及び流路出口端面に貫通する多数の流通孔を、流路入口端面及び流路出口端面で互い違いに目封じして目封じハニカム体を作製し、次いで、ハニカム体と実質的に同材質からなる接合層を、目封じハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の目封じハニカム体を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法が提供される。

**【0023】** また、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、ハニカム体を焼成してハニカム部材を得、次いで、ハニカム部材の、流路入口端面及び流路出口端面に貫通する多数の流通孔を、流路入口端面及び流路出口端面で互い違いに目封じしてハニカムフィルター部材を作製し、次いで、ハニカム体と実質的に同材質からなる接合層を、ハニカムフィルター部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数のハニカムフィルター部材を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法が提供される。

**【0024】** さらに、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体を得、次いで、ハニカム体の流路入口端面及び流路出口端面に貫通する多数の流通孔を、流路入口端面及び流路出口端面で互い違いに目封じして目封じハニカム体を作製し、次いで、ハニカム体と実質的に同材質の接合層を、目封じハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の目封じハニカム体を、接

合層を介して接合して一体化した後、外形を加工し、その後焼成することを特徴とするハニカムフィルターの製造方法が提供される。

**【0025】** さらにまた、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、ハニカム体の外形を加工し、次いで、ハニカム体の流路入口端面及び流路出口端面に貫通する多数の流通孔を、流路入口端面及び流路出口端面で互い違いに目封じして目封じハニカム体を作製し、次いで、ハニカム体と実質的に同材質の接合層を、目封じハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数の目封じハニカム体を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法が提供される。

**【0026】** さらにまた、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とした後、更に、ハニカム体の外形を加工した後、焼成してハニカム部材を得、次いで、ハニカム部材の流路入口端面及び流路出口端面に貫通する多数の流通孔を、流路入口端面及び流路出口端面で互い違いに目封じしてハニカムフィルター部材を作製し、次いで、ハニカム体と実質的に同材質の接合層を、ハニカムフィルター部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数のハニカムフィルター部材を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法が提供される。

**【0027】** さらにまた、本発明によれば、原料粉末、バインダー及び水を混練し、得られた混練物を成形、乾燥してハニカム体とし、次いで、該ハニカム体を焼成してハニカム部材とした後、該ハニカム部材の外形を加工し、次いで、該ハニカム部材の流路入口端面及び流路出口端面に貫通する多数の流通孔を、流路入口端面及び流路出口端面で互い違いに目封じしてハニカムフィルター部材を作製し、次いで、ハニカム体と実質的に同材質の接合層を、ハニカムフィルター部材における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成し、次いで、複数のハニカムフィルター部材を、接合層を介して接合して一体化した後、焼成することを特徴とするハニカムフィルターの製造方法が提供される。

**【0028】** これらハニカム構造体等の製造方法では、接合層を、連続的に形成することが好ましい。また、得られたハニカム構造体等の外形を、更に加工してもよい。

**【0029】** また、ハニカム構造体等の側面の少なく

とも一部に、耐熱無機材料を主成分とする充填材を塗布することが好ましく、ハニカム構造体等を製造後、触媒を担持してもよい。

【0030】また、接合層を一部に形成した面の、接合層が形成されていない部分の少なくとも一部に、耐熱無機材料を主成分とする充填材を配設することが好ましい。

【0031】ハニカム部材及び接合層の主成分としては、コーボライト、ムライト、アルミナ、スピネル、炭化珪素、窒化珪素、リチウムアルミニウムシリケート、チタン酸アルミニウム及びこれらの組み合わせによる群から選ばれる少なくとも1種のセラミックス、Fe-Cr-Al系金属、又は金属SiとSiCからなることが好ましい。

### 【0032】

**【発明の実施の形態】**本発明のハニカム構造体等は、複数のハニカム部材又はハニカムフィルター部材（以下、「ハニカム部材等」と省略していることがある。）が、ハニカム部材と実質的に同材質の接合部材により接合されているため、ハニカム部材と接合部材のフィルター使用時における熱膨張率が略同一となり、熱応力の発生を抑制することができる。

【0033】また、本発明者の鋭意検討によると、熱応力は流路入口端面外周部又は流路出口端面外周部で極めて大きいことが分かっており、本発明では、接合面を、この部分に接続する端部を少なくとも含んで、一部に未接合部を有するように構成しているため、前述した接合材による熱応力低減効果に加え、更に効果的にハニカム構造体等に発生する熱応力を低減することができ、クラック等が発生しない、耐久性に優れるハニカム構造体等とすることができます。

【0034】以下、本発明に係るハニカム構造体等の各構成要素について詳しく説明する。

【0035】本発明に係るハニカム構造体は、隔壁により仕切られた多数の流通孔を有するハニカム部材を複数一体化してなるものであり、本発明のハニカムフィルターは、隔壁により仕切られ、流路入口端面及び流路出口端面に貫通する多数の流通孔を、流路入口端面及び流路出口端面で互い違いに目封じされてなるハニカムフィルター部材を複数一体化してなるものである。

【0036】本発明におけるハニカム部材等において、流通孔の断面形状（セル形状）は、製作上の観点から、三角形、四角形、六角形又はコルゲート形状のいずれかであることが好ましい。

【0037】また、隔壁により形成されるセルのセル密度は、ハニカム部材としての強度及び有効GSA（幾何学的表面積）、更にはガスが流れる場合の圧力損失を考慮して、6～2000セル/平方インチ（0.9～311セル/cm<sup>2</sup>）が好ましく、50～400セル/平方インチ（7.8～62セル/cm<sup>2</sup>）が更に好まし

い。

【0038】また、ハニカム部材の形状としては、例えば、円柱形状を、その中心軸を通るように軸方向に3分割又は4分割に切断し、軸方向と垂直方向の断面形状が、扇形となるような形状のもの；円柱形状を、軸方向に一定間隔で9分割以上に切断し、軸方向と垂直方向の断面形状が、各セグメントで扇形、四角等の異なる形状となるもの等を挙げることができる。中でも、接触面を、多数、且つ3次元的に設けることによりハニカムフィルターの熱応力を低減することができる点から、ハニカム部材を9分割以上に切断した形状のものが好ましい。

【0039】他方、本発明におけるハニカム部材は、強度、耐熱性等の観点から、コーボライト、ムライト、アルミナ、スピネル、炭化珪素、窒化珪素、リチウムアルミニウムシリケート、チタン酸アルミニウム及びこれらの組み合わせによる群から選ばれる少なくとも1種のセラミックス、Fe-Cr-Al系金属からなることが好ましく、中でも、熱伝導率が高く放熱しやすいという点で炭化珪素が好ましい。

【0040】また、本発明においては、金属SiとSiCを主成分とすることも好ましく、この際には、ハニカム部材のSi/(Si+SiC)で規定されるSi含有量が、5～50重量%であることが好ましく、10～40重量%であることがさらに好ましい。5重量%未満ではSiによる結合が不十分であるため、熱伝導率、強度が不足する場合があり、一方、50重量%を超えると過度に収縮してしまい、気孔率低下、気孔径縮小などの弊害を生じる場合がある。

【0041】本発明においては、流通孔を目封じする目封じ部材について特に制限はなく、例えば、ハニカム部材と同様のセラミックス及び／又は金属からなるものを挙げることができる。

【0042】本発明においてハニカム部材は、上述したセラミックス及び／又は金属からなる原料粉末に、バインダー及び水を所定量投入した後、混練し、得られた混練物を、成形して所望の形状とした後、成形体の乾燥を行ってハニカム体を得、最後に、このハニカム体を焼成することにより得ることができる。

【0043】本発明におけるハニカム部材は、寸法精度を向上させるために、後述する接合材による接合前に、その外形を加工しておこくことが好ましい。また、この外形の加工は、成形して得られるハニカム体に対して行ってよい。

【0044】本発明で用いられるバインダーとしては、例えば、ヒドロキシメチルセルロース、メチルセルロース、ヒドロキシエチルセルロース、カルボキシルメチルセルロース、又はポリビニルアルコール等を挙げることができ、これらバインダーは、一種単独で又は二種以上を組み合わせて用いることができる。

【0045】 また、本発明では、その他に、成形助剤として一般的に使用されるエチレングリコール、デキストリン、脂肪酸石鹼、又はポリアルコール等を必要に応じて添加してもよい。

【0046】 投入する水の量は、通常、上述した粉末原料100重量部に対して、10～40重量部程度であり、水を投入後、得られた混合原料を、真空土練機等で混練し、可塑性とする。

【0047】 成形方法は、押出成形が好ましく、例えば、ラム式押出し成形機、2軸スクリュー式連続押出成形装置等を用いて行うことができる。

【0048】 また、乾燥方法としては、例えば、熱風乾燥、マイクロ波乾燥、誘電乾燥、減圧乾燥、真空乾燥、凍結乾燥等を挙げることができ、中でも、誘電乾燥、マイクロ波又は熱風乾燥を単独で又は組合せて行うことが好ましい。更に、焼成条件については、用いる材料の種類により適宜所望の条件を選択すればよい。

【0049】 また、本発明のハニカムフィルターにおいて、流通孔を目封じする際には、成形乾燥後のハニカム体の流通孔を目封じて目封じハニカム体としてもよく、更に焼成した後のハニカム部材の流通孔を目封じてハニカムフィルター部材としてもよい。中でも、目封じ部材の接合強度が大きい点で、ハニカム体の流通孔を目封じて目封じハニカム体とすることが好ましい。

【0050】 本発明においては、複数のハニカム部材等が、ハニカム部材と実質的に同材質の主成分からなる接合部材により、流通孔の流路方向と実質的に平行な面が接合されて一体化されてなるものであり、接合面が、少なくとも、流路入口端面外周部又は流路出口端面外周部に接続する端部を含む未接合部を有している。

【0051】 ここで、本明細書中、「接合面」とは、一部に接合材が配設されている面を意味する。また、「未接合部」とは、接合面のうち、接合材の配設されていない部分を意味する。更に、「実質的に平行な面」とは、複数のハニカム部材を接合する際に障害にならない範囲で厳密な意味で平行でない面も含む意味である。

【0052】 本発明においては、接合部材は、接合面に不連続的に2箇所以上で配設されているもの、接合面に連続的に配設されているもの、のいずれでもよいが、ハニカム部材等の接合強度を高くできる点で、接合面に連続的に配設されているものが好ましい。

【0053】 また、接合部材の形状としては、例えば、ハニカム構造体の軸方向の断面形状が、三角形、長方形、正方形、菱形、台形、楕円、円形、トラックサークル形状、半楕円形、又は半円形の等を挙げができるが、フィルター全体の温度を均一化し易い点で、楕円、円形、トラックサークル形状等が好ましい。

【0054】 未接合部は、ハニカム構造体等の流路入口端面外周部又は流路出口端面外周部から流通孔の流路方向に、同方向のハニカム構造体等の全長に対し、10

%以上の長さで形成されていることが好ましく、30%以上の長さで形成されていることがより好ましい。この範囲であれば、ハニカム構造体等全体の熱応力を効果的に低減することができ、クラック等の発生を抑制し耐久性を向上させることができる。

【0055】 また、未接合部は、更にハニカム構造体等の流路入口端面外周部又は流路出口端面外周部から各端面の中心方向に、同方向のハニカム構造体等の全幅に対して10%以上の長さで形成されていることが好ましく、30%以上の長さで形成されていることがより好ましい。これにより、より熱応力を低減することができ、耐久性を更に向上させることができる。

【0056】 また、本発明においては、接合部をハニカム構造体等の略中心部に設け、未接合部が、接合面におけるハニカム構造体等の側面、流路出口端面及び流路入口端面に接続する部分全部を含んで設けられていることが好ましい。これにより、ハニカム構造体等で熱応力が発生し易い部分がいずれも容易に変形が可能となり、クラック等の発生を高度に抑制することができる。

【0057】 更に、本発明においては、未接合部が、各部の変形に偏りを生じにくい点で、ハニカム構造体等の中心軸を基準に線対称に配置されていることが好ましいが、例えば、図11(a)～(d)に示すように、未接合部12を、ハニカム構造体等の中心軸を基準に、非線対称に配置するものであってもよい。

【0058】 他方、本発明における接合材は、上述の通り、ハニカム部材と実質的に同材質のものである。

【0059】 具体的には、ハニカム部材のところで述べたコーチェライト、ムライト、アルミナ、スピネル、炭化珪素、窒化珪素、リチウムアルミニウムシリケート、チタン酸アルミニウム及びこれらの組み合わせによる群から選ばれる少なくとも1種のセラミックス、又はFe-Cr-Al系金属等からなり、ハニカム部材の成分と対応させたものを挙げることができる。

【0060】 他方、ハニカム部材が金属SiとSiCとを主成分とする場合には、接合材も金属SiとSiCを主成分とすることが好ましいが、この際には、Si/(Si+SiC)で規定されるSi含有量が、接合されるハニカム部材と同等かそれより多く、かつ10～80重量%であることが好ましい。Si含有量がハニカム部材に比べて同等未満では、充分な接合強度が得られない場合があり、80重量%を超えると、高温での耐酸化性が不充分となる場合がある。

【0061】 本発明において、接合部材は、ハニカム体と実質的に同材質の接合層を、ハニカム体における流通孔の流路方向と実質的に平行な面に、少なくとも流路入口端面外周部又は流路出口端面外周部に接続する端部を除いて一部に形成した後、焼成することにより設けることができる。

【0062】 もっとも、本発明のハニカム構造体にお

いては、成形、乾燥後のハニカム体をさらに焼成して得たハニカム部材に接合層の形成した後、焼成することにより接合部材を設けることもできる。また、本発明のハニカムフィルターにおいても、ハニカム体の流通孔を目封じした目封じハニカム体に接合層の形成した後、焼成することにより接合部材を設けてもよく、ハニカム部材を目封じしたハニカムフィルター部材に接合層の形成した後、焼成することにより接合部材を設けてもよい。

【0063】接合層を形成する方法としては、所定の面にハニカム体と実質的に同材質のスラリーを直接塗布しても良いが、所定の厚みを確保するために、同様の材質のもので形成した所定の厚みのプレートを用い、これに同材質のスラリーを塗布して接合することが好ましい。また、接合層は、ハニカム部材等の接合強度を大きくするために、連続的に形成することが好ましい。

【0064】本発明のハニカム構造体等は、このように接合層を形成したハニカム体又は等の複数を一体化した後焼成して得ることができる。焼成条件は、接合する上で好適な条件であればよく、接合材の材料に応じて適宜好適な熱処理温度を選択すればよい。但し、一般には200～400℃の温度で行うことが好ましい。

【0065】本発明においては、未接合部の少なくとも一部に、耐熱無機材料を主成分とする充填部材が配設されていることが好ましい。これにより、ガスなど流体の未接合部からの吹き抜け（通り抜け）を防止することができる。

【0066】尚、本発明のハニカムフィルターに充填部材を配設する場合は、充填部材を、少なくとも未接合部により形成される空隙が流路入口端面に露出する部分全てを閉塞するように、未接合部の一部に配設することが好ましい。これにより、未接合部に煤が堆積することを防止することができるとともに、流路入口端面1・6側に配設された充填部材と接合材間、及び流路出口端面1・4に露出する空隙によりハニカムフィルターに生じる熱応力を高度に低減することができる。

【0067】耐熱無機材料を主成分とする充填部材としては、耐熱性を有するセラミックスファイバー、セラミックス粉、セメント等を単独で、あるいは混合して用いることが好ましく、更に必要に応じて、有機バインダー、無機バインダー等を混合して用いてもよい。

【0068】また、本発明における充填部材としては、①ヤング率が、ハニカム部材のヤング率の80%以下であること、②材料強度が、ハニカム部材の材料強度より小さいこと、の少なくともいずれか一方を満足することが好ましく、これらの両方を満足することがより好ましい。

【0069】少なくとも、これらいずれか一方を満足すると、熱応力低減効果が大きく、ハニカム構造体等の耐久性がさらに向上するからである。ここで、ヤング率は、静的弾性率試験法により荷重と変位量の関係から測

定算出したものであり、材料強度は、材料試験機を用いて4点曲げ強度試験（JIS1601）により測定したものである。

【0070】本発明においては、さらに、得られたハニカム構造体等の側面の少なくとも一部に上述した充填材を塗布して、耐熱性を向上させることも好ましい。

【0071】尚、充填部材は、ハニカム部材等又はハニカム体等を一体化して焼成した後に、充填材を充填し、乾燥、更に必要に応じて焼成して配設してもよく、

10 一体化して焼成する前に充填材を充填した後、ハニカム部材等又はハニカム体等とともに焼成して配設してもよい。

【0072】また、本発明においては、容器等の寸法合わせ等を考慮して、一体化した後にハニカム部材等（ハニカム構造体等）の外形を加工してもよく、更に焼成した後にハニカム部材等（ハニカム構造体等）の外形を加工してもよい。

【0073】本発明において、一体化したハニカム構造体等は、流通孔の流路方向に垂直方向の断面形状が、円、楕円、レーストラック等、各種の形状を探り得る。

20 【0074】また、本発明においては、このようなハニカム構造体等を、触媒担体として内燃機関等の熱機関若しくはボイラー等の燃焼装置の排気ガスの浄化、又は液体燃料若しくは気体燃料の改質に用いようとする場合には、ハニカム部材等に例えば、Pt、Pd、Rh等の触媒能を有する金属少なくとも1種を担持することが好ましい。

【0075】また、ハニカムフィルターとして用いる場合には、捕捉された粒子状物質が隔壁上に堆積していくと、目詰まりを起こしてフィルターとしての機能が低下するので、定期的にヒーター等の加熱手段でハニカムフィルターを加熱することにより、粒子状物質を燃焼除去し、フィルターを再生することを行う。従って、ハニカムフィルターの場合には、フィルター再生時の粒子状物質の燃焼を促進するために、隔壁上にそのような触媒能を有する金属を担持させてもよい。

【0076】以下、本発明を図面に示す実施形態に基づき更に詳細に説明するが、本発明はこれらの実施形態に限定されるものではない。

40 【0077】図1(a) (b) (c) (d)は本発明に係るハニカム構造体の各種実施例を示す斜視図である。図1(a) (b) (c) (d)に示すハニカム構造体10は、隔壁により仕切られた軸方向（流路方向）

（図1(a) (b) (c) (d)で、X方向で示す。）に貫通する多数の流通孔11を有するハニカム部材21を4個接合して構成されている。また、ハニカム部材21は、ハニカム部材21と実質的に同材質の接合部材25により、流通孔11の流路方向Xと実質的に平行な面（接合面）22で接合されており、この接合面22のうち、未接合部12は、流路出口端面外周部15に接続す

る端部18を含んで設けられ、接合部材25は、連続的に配設されている。

【0078】ここで、図1(a)に示すハニカム構造体10は、未接合部12が、接合面22のうち、流路出口端面14及び側面13に接続する部分の一部を含んで、側面13からハニカム構造体10の中心方向Yの幅が流路入口端面16方向に徐々に小さくなるように斜めに形成されている。また、図1(b)に示すハニカム構造体10は、未接合部12が、同様に流路出口端面14及び側面13に接続する部分の一部を含んで形成されているが、未接合部12の形状が矩形であり、側面13からハニカム構造体10の中心方向Yの幅が流路入口端面16方向に同一になるように形成されている。また、図1(c)に示すハニカム構造体10は、未接合部12が、接合面22のうち、側面13に接続する部分全体と、流路出口端面14に接続する一部を含んで、側面13からハニカム構造体10の中心方向Yの幅が流路入口端面16方向に徐々に小さくなるように斜めに形成されている。また、図1(d)に示すハニカム構造体10は、未接合部12が、接合面22のうち、側面13に接続する部分全体と、流路出口端面14及び流路入口端面16に接続する一部を含んで、側面13からハニカム構造体10の中心方向Yの幅が流路出口端面方向に同一になるように形成されている。

【0079】図1(a)(b)(c)(d)に示すハニカム構造体10では、局所的な高温又は低温のような温度分布の不均一が生じても、ハニカム構造体10の各部が互いに拘束されずに自由に変形でき、熱応力が低減され、クラックの発生が極力防止される。

【0080】特に、図1(c)(d)に示すハニカム構造体10では、ハニカム構造体10全体で熱応力を低減する効果が大きいため、温度の不均一がハニカム構造体10全体に及ぶような使用環境において特に有効である。

【0081】図2(a)(b)に示すハニカム構造体10は、ハニカム部材21を3個接合して構成されるものである。図2(a)に示すハニカム構造体10は、図1(c)と同様に、未接合部12が、接合面22のうち、側面13に接続する部分全体と、流路出口端面14に接続する一部を含んで、側面13からハニカム構造体10の中心方向Yの幅が流路入口端面16方向に徐々に小さくなるように斜めに形成されている。また、図2

(b)に示すハニカム構造体10は、図1(d)と同様に、未接合部12が、接合面22のうち、側面13に接続する部分全体と、流路出口端面14及び流路入口端面16に接続する一部とを含んで、側面13からハニカム構造体10の中心方向Yの幅が流路入口端面16方向に同一になるように形成されている。

【0082】このようなハニカム構造体でも、図1(a)(b)(c)(d)に示すハニカム構造体10と

略同様の熱応力低減効果を発揮することができる。

【0083】図3(a)(b)は、本発明に係るハニカム構造体の他の実施例を示す斜視図である。

【0084】図3(a)に示すハニカム構造体10は、未接合部12が、接合面22のうち、ハニカム構造体10の側面13に接続する部分の一部と、流路出口端面14に接続する部分の全部とを含んで設けられている。また、この例では、未接合部12が、端面外周部15の2点(A, B)、(C, D)を連続的につないで流路出口端面14の中央部で交差するように設けられている。

【0085】このようなハニカム構造体10では、流路出口端面14における熱応力の低減効果が大きいという利点を有する。

【0086】図3(b)に示すハニカム構造体10は、更に、未接合部12が、接合面22のうち、ハニカム構造体10の側面13に接続する部分の一部と、流路入口端面16に接続する部分の全部とを含んで設けられ、未接合部12が、流路出口端面14と同様に、端面外周部17の2点(図示せず)を連続的につないで流路入口端面16の中央部で交差するように設けられている。

【0087】このようなハニカム構造体10では、流路出口端面14と流路入口端面16とで熱応力の低減効果が大きく、クラックの発生を更に抑制することができる。

【0088】図4(a)(b)(c)(d)に示すハニカム構造体10は、接合部材25がハニカム構造体10の中心部に配設され、未接合部12が、接合面22のうち、ハニカム構造体10の側面13、流路出口端面14及び流路入口端面16に接続する部分全部を含んで設けられているものである。図4(a)は、接合部材25の断面形状が長方形の場合、図4(b)は、接合部材25の断面形状が円形の場合、図4(c)は、接合部材25の断面形状がレーストラック形の場合、図4(d)は、接合部材25の断面形状が菱形の場合をそれぞれ示す。

【0089】このようなハニカム構造体10では、極めて熱応力の低減効果が大きく、局所的な高温又は低温の如く温度の不均一が大きく、その不均一がハニカム構造体の全体にわたって分布するような場合においても、クラック等を生じないハニカム構造体とすることができます。

【0090】一方、図5(a)(b)(c)(d)に示すハニカム構造体10は、未接合部12が、接合面22のうち、ハニカム構造体10の側面13及び流路出口端面14に接続する部分の全部と、流路入口端面16に接続する部分の一部とを含んで設けられ、接合部材25の一部が、ハニカム構造体10の流路入口端面16に露出して設けられているものである。

【0091】このハニカム構造体では、特に、流路出口端面14及び側面13における熱応力を低減する効果が大きいという利点を有する。

【0092】図6(a)(b)及び図7(a)(b)(c)(d)に示すハニカム構造体10は、図4(a)(b)(c)に示すハニカム構造体10と同様に、未接合部12が、接合面22のハニカム構造体10の側面13、流路出口端面14及び流路入口端面16に接続する部分全部を含んで設けられているものであり、更に、ハニカム部材14を9個接合して構成することにより、接合面22を多数設けたものである。

【0093】図6(a)(b)に示すハニカム構造体10は、図4(a)と同様に、接合部材25の断面形状が長方形の場合を示しており、図7(a)(b)に示すハニカム構造体10は、接合部材25の断面形状が橢円形の場合を示している。

【0094】このハニカム構造体10では、図4(a)～(d)に示すハニカム構造体10のところで述べた効果に加え、未接合部12をハニカム構造体10中に、多数かつ均一に設けることができるため、ハニカム構造体10の熱応力を極めて低減することができる。

【0095】図8(a)(b)に示すハニカム構造体10は、図4(a)(b)(c)(d)に示すハニカム構造体10と同様に、4個のハニカム部材21を、接合部材25で接合したものであり、接合部材25がハニカム構造体10の中心部に配設され、未接合部12が、接合面22のハニカム構造体10の側面13、流路出口端面14及び流路入口端面16に接続する部分全部を含んで設けられている。また、このハニカム構造体10では、充填部材24が、接合部材25の周囲に側面13の一部に露出するように未接合部12の一部に配設されており、充填部材24が配設されず空隙を形成している未充填部31が、接合面22のうち、ハニカム構造体10の側面13の一部に接続する部分の一部と、流路出口端面14及び流路入口端面16に接続する部分の全部とを含んで設けられている。

【0096】このハニカム構造体10では、充填部材24の存在により、流体が、未接合部12を流路方向に流れることができるとともに、流路出口端面14及び流路入口端面16に接続する部分の全部に未充填部31が設けられているため、熱応力の低減効果が極めて大きいという利点を有する。

【0097】図9(a)(b)に示すハニカム構造体10は、図6(a)(b)に示すハニカム構造体10と同様に、ハニカム部材14を9個接合して構成することにより、接合面22を多数設けたものであることは、図8(a)(b)に示すハニカム構造体10と同様の構成としたものである。

【0098】このハニカム構造体10では、図8

(a)(b)に示すハニカム構造体10のところで述べた効果に加え、未接合部12をハニカム構造体10中に、多数かつ均一に設けることができるため、ハニカム構造体10の熱応力を極めて低減することができる。

【0099】図10(a)(b)(c)は、ハニカムフィルターとして用いる場合の実施形態を示すものである。図10(a)(b)(c)に示すハニカムフィルター1では、図4(a)(b)(c)(d)に示すハニカム構造体10と同様に、4個のハニカムフィルター部材33を、接合部材25で接合したものであり、接合部材25がハニカムフィルター1の中心部に配設され、未接合部12が、接合面22のハニカムフィルター1の側面13、流路出口端面14及び流路入口端面16に接続する部分全部を含んで設けられている。また、このハニカムフィルター1では、充填部材24を、未接合部12により形成される空隙が流路入口端面16に露出する部分全てを閉塞するように未接合部12の一部に配設されており、流路入口端面16側に配設された充填部材24と接合部材25間、及び流路出口端面14に露出して、充填材が配設されず空隙を形成している未充填部31が形成されている。

【0100】このハニカムフィルター1では、ガス流入側の未充填部31に排ガス中のすすが堆積することなく、ハニカムフィルターとして好適に用いることができるとともに、流路出口端面14及び流路入口端面16の近傍に空隙が形成されているため、極めて熱応力の低減効果が大きいという利点を有する。

【0101】次に、本発明に係るハニカム構造体及びハニカムフィルターの製造方法の例について説明するが、本発明はこれらに限定されるものではない。

【0102】(製造例1)原料として、SiC粉75重量%及び金属Si粉25重量%の混合粉末を使用し、これにメチルセルロース及びヒドロキシプロポキシルメチルセルロース、界面活性剤及び水を添加し、可塑性の坏土を作製した。

【0103】次いで、この坏土を押出成形して、それぞれ、円柱形状を軸方向に一定間隔で9分割に切断して得られる軸方向と垂直方向の断面形状が、扇形、四角等の異なる形状を有し、隔壁の厚さが0.3mm、セル密度が31セル/cm<sup>2</sup>のハニカム体を複数作製した。

【0104】次いで、これら複数のハニカム体をマイクロ波及び熱風で乾燥後、ハニカム体における流通孔の流路方向と実質的に平行な面の略中央部分に坏土と同じ組成の接合層を形成し、その後、この各ハニカム体を、この接合層を介して接合させることにより、一体に組立てた後、乾燥した。得られた組立後の乾燥体をN<sub>2</sub>雰囲気中約400℃で脱脂し、その後、Ar等の不活性雰囲気中で約1550℃で焼成した。焼成後、未接合部の外周部に、例えば、アルミニシリケート質ファイバー、SiC粉、金属Si粉、有機バインダー、無機バインダ

一、及び水を含む充填材を幅5～10mmに充填し、約100℃で乾燥することにより、寸法が、 $144\text{ mm}\phi \times 152\text{ mmL}$ 、接合部の隙間が2mmである図9に示すハニカム構造体を作製することができた。

**【0105】** (製造例2) 製造例1において、端面形状が $50\text{ mm} \times 50\text{ mm}$ の角柱形状のハニカム体を成形し、複数のハニカム体を接合して一体化した後、焼成し、得られたハニカム構造体の外形を加工して、寸法が、 $144\text{ mm}\phi \times 152\text{ mmL}$ の円柱形状としたこと及び、次いで、接合層と同様の坏土を周を塗布し焼成することにより、ハニカム構造体を作製したこと以外は製造例1と同様にして図9に示すハニカム構造体を作製することができた。

**【0106】** (製造例3) 製造例1と同様にして、端面形状が $50\text{ mm} \times 50\text{ mm}$ の角柱形状のハニカム体を成形し、複数のハニカム体を接合して一体化した後、焼成し、得られたハニカム構造体の外形を加工して、寸法が、 $144\text{ mm}\phi \times 152\text{ mmL}$ の円柱形状としたこと及び、次いで、充填材で外周を塗布し乾燥することにより、ハニカム構造体を作製したこと以外は製造例1と同様にして図9に示すハニカム構造体を作製することができた。

**【0107】** (製造例4) ハニカムフィルターは、ハニカム部材流路の両端面を互い違いに目封じする工程を行う以外は、上記した製造例1～3同様の方法により、製造することができた。

#### 【0108】

**【実施例】** 以下、本発明を具体的な実施例に基づいて更に詳細に説明するが、本発明はこれらの実施例に限定されるものではない。

#### 【0109】 実施例1

製造例1により、寸法が $144\text{ mm}\phi \times 152\text{ mmL}$ 、隔壁の厚さが0.3mm、セル密度が31セル/ $\text{cm}^2$ のSiC製ハニカム体の、流路入口端面及び流路出口端面に貫通する多数の流通孔を、流通孔が貫通する流路入口端面及び流路出口端面で互い違いに目封じしたディーゼルエンジン排気浄化パーティキュレートハニカムフィルターを作製した。また、このハニカムフィルターでは、図1(a)に示すように、未接合部12を、接合面22のうち、流路出口端面(上端面)14及び側面13に接続する部分の一部を含んで、側面13からハニカム構造体10の中心方向Yの幅が流路入口端面16方向に徐々に小さくなるように斜めに設けており、未接合部12の長さを、流路出口端面(上端面)外周部15からハニカム構造体10の流路方向に30mm、流路出口端面(上端面)外周部15からハニカム構造体10の中心方向に50mmとした。

#### 【0110】 実施例2～6、10

実施例1において、それぞれ、図1(d)、図3(a)、図3(b)、図4(a)、図4(b)、及び図

7に示す未接合部を有する構造としたこと及び、ハニカム構造体10の未接合部12間で形成される空隙が、流路入口端面(下端面)16に露出して形成される場合には、その露出する部分を、閉塞するように、表1に示す特性の充填部材25を深さ6mmで配設した以外は実施例1と同様のものを作製した。

**【0111】** 尚、表1中、ヤング率比とは、ハニカム部材のヤング率に対する充填材のヤング率の比であり、各ヤング率については、静的弾性率試験法により荷重と変位量の関係から測定算出した。また、強度とは、ハニカム部材に対する充填材の材料強度をいい、各材料強度については材料試験機を用いて4点曲げ強度試験(JIS1601)により測定した。また、充填材の方が強度が大きい場合を「大」、小さい場合を「小」と示した。

#### 【0112】 実施例7～9

実施例6において、充填材を、表1に示すヤング率比及び強度のものを用いたこと以外は、実施例6と同様のものを作製した。

#### 【0113】 実施例11

実施例1において、未接合部12を、流路出口端面(上端面)外周部15からハニカム構造体10の中心方向に15mmの長さ、流路出口端面(上端面)外周部15からハニカム構造体10の流路方向に、5mmの長さで設けたこと以外は、実施例1と同様のものを作製した。

#### 【0114】 実施例12、13

実施例1において、図3(a)に示す構造にするとともに、未接合部12を、それぞれ上端面外周部15からハニカム構造体10の流路方向に15、5mmの長さ、上端面外周部15からハニカム構造体10の中心方向に、15、5mmの長さで設けたこと以外は、実施例1と同様のものを作製した。

#### 【0115】 比較例1

未接合部を有しない一体構造のものを作成したこと以外は実施例1と同様のものを作成した。

**【0116】** (評価) ハニカム構造体(ハニカムフィルター)10の側面13に把持材としてセラミック製無膨張マットを巻き、SUS409製のキャニング用缶体に押し込んでキャニング構造体とした後、ディーゼル燃料軽油の燃焼により発生させたすすを含む燃焼ガスを、ハニカム構造体(ハニカムフィルター)10の下端面16より流入させ、上端面14より流出させることにより、すすをハニカム構造体(ハニカムフィルター)10内に捕集し、次に一旦室温まで放冷した後、ハニカム構造体(ハニカムフィルター)10の下端面16より800℃で一定割合の酸素を含む燃焼ガスを流入させることにより、すすを燃焼除去するフィルタ再生試験を実施した。

**【0117】** 実施例1～10及び比較例1のハニカムフィルターでは、入口ガス温度を室温から800℃まで上昇させる過渡時間と、捕集すす重量を3種類(過渡時間:標準条件(300秒)、短(240秒)、最短(180秒))

0秒) (捕集すす重量: 標準条件(10g/L)、大(14g/L)、最大(18g/L)) 設定し、試験を実施した際、ハニカム構造体の上端面(出口)、下端面(入口)、外周、内部のそれぞれの部位でのクラックの発生の有無を調査した。

【0118】一方、実施例1、11~13のハニカムフィルターでは、捕集すす重量を定量的に10g/L~\*

\* 20g/Lの6種類(過渡時間: 標準条件)で設定し、上述と同様にしてフィルタ再生試験を実施した。結果をまとめて表1及び2に示す。なお、クラックの発生については、全く発生しなかったものを○、少しでも発生したもの△で示した。

【0119】

【表1】

構造	充填材 ヤング率比	捕集すす量		過渡時間		最大		短		標準				
				最短		最長				標準				
		クラック調査部位		入口	出口	内部	外周	入口	出口	内部	外周			
		充填材 ヤング率比	強度											
実施例1	図1(a)	80%	小	△	△	△	△	○	○	△	○	○	○	○
実施例2	図1(d)	80%	小	△	△	△	△	○	○	○	○	○	○	
実施例3	図3(a)	80%	小	△	○	△	△	○	△	△	○	○	○	
実施例4	図3(b)	80%	小	○	○	△	△	○	○	△	○	○	○	
実施例5	図4(a)	80%	小	○	○	△	△	○	○	○	○	○	○	
実施例6	図4(b)	80%	小	○	○	○	△	○	○	○	○	○	○	
実施例7	図4(b)	83%	小	○	○	△	△	○	○	△	○	○	○	
実施例8	図4(b)	80%	大	○	○	△	△	○	○	△	△	○	○	
実施例9	図4(b)	85%	大	○	△	△	△	○	○	△	○	○	○	
実施例10	図7	80%	小	○	○	○	○	○	○	○	○	○	○	
比較例1	未接合部無し	80%	小	△	△	△	△	△	△	△	△	○	○	

【0120】

※※【表2】

構造	未接合部	実施例1		実施例11		実施例12		実施例13	
		図1(a)	図1(e)	図3(a)	図3(a)	50mm	15mm	15mm	5mm
ハニカム構造体	中心方向長さ	30mm	30mm	5mm	15mm	15mm	5mm	5mm	5mm
	流路方向長さ	144mm							
	直徑	152mm							
補集すす量 (g/L)	全長	○	○	○	○	○	○	○	○
	10	○	○	○	○	○	○	○	○
	12	○	○	○	○	△	△	△	△
	14	○	△	○	○	○	○	○	○
	16	○	△	○	○	○	○	○	○
	18	○	△	○	○	△	△	△	△
	20	○	△	△	△	△	△	△	△

【0121】表1からわかるように、標準条件の場合であっても、未接合部なし構造の比較例1のハニカム構造体においては、入口及び出口の端面にクラックの発生が認められるのに対し、実施例1~10のハニカムフィルター(図1(a)、図1(d)、図3(a)、図3(b)、図4(a)、図4(b)、図7)では、クラックの発生はなかった。

【0122】なお、過渡時間を短くし捕集すす重量を増加させていくと、温度の不均一が大きくなり、図1(a)や図3(a)のように、ハニカムフィルターの外周部の一端面付近にのみ未接合部が形成されている場合には一部クラックの発生が生じることがあったが、図4(b)のように、未接合部が、接合面におけるハニカムフィルターの側面、流路出口端面及び流路入口端面に接続する部分全部を含んで設けられているハニカムフィルターではほとんどクラックは発生せず、図7のようにさらに接合面数を増やした例ではまったくクラックの発生は認められなかった。また、充填材のヤング率がハニカム部材のヤング率の80%以下であるか、または充填材

の材料強度がハニカム部材より小さいと、クラックの発生は少なかった。

【0123】また、表2から分かるように、未接合部分の、上端面外周部15からハニカム構造体10の流路方向及び中心方向の長さが、所定以上に短くなると、すす量の増大に応じてクラックの発生する割合が増大する傾向が認められた。

【0124】

40 【発明の効果】以上説明したように、本発明のハニカム構造体及びハニカムフィルターによれば、温度分布の不均一が生じても、ハニカム構造体及びハニカムフィルターの各部が互いに拘束されずに自由に変形することができるため、熱応力を低減することができ、その結果、クラックの発生を防止することができるという効果を奏する。

【図面の簡単な説明】

【図1】本発明に係るハニカム構造体の各種実施例を示す斜視図である。

50 【図2】本発明に係るハニカム構造体の他の各実施例

を示す斜視図である。

【図3】 本発明に係るハニカム構造体の他の各実施例を示す斜視図である。

【図4】 本発明に係るハニカム構造体の更に他の各実施例を示す斜視図である。

【図5】 本発明に係るハニカム構造体の更に別の各実施例を示す斜視図である。

【図6】 本発明に係るハニカム構造体の更に別の実施例を示しており、(a)は斜視図、(b)は(a)のY-Y断面説明図である。

【図7】 本発明に係るハニカム構造体の更に別の実施例を示しており、(a)は斜視図、(b)は(a)のZ-Z断面説明図である。

【図8】 本発明に係るハニカム構造体の更に別の実施例を示しており、(a)は側面図、(b)は(a)のA-A断面説明図である。

【図9】 本発明に係るハニカム構造体の更に別の実施例を示しており、(a)は側面図、(b)は(a)のB-B断面説明図である。

-B断面説明図である。

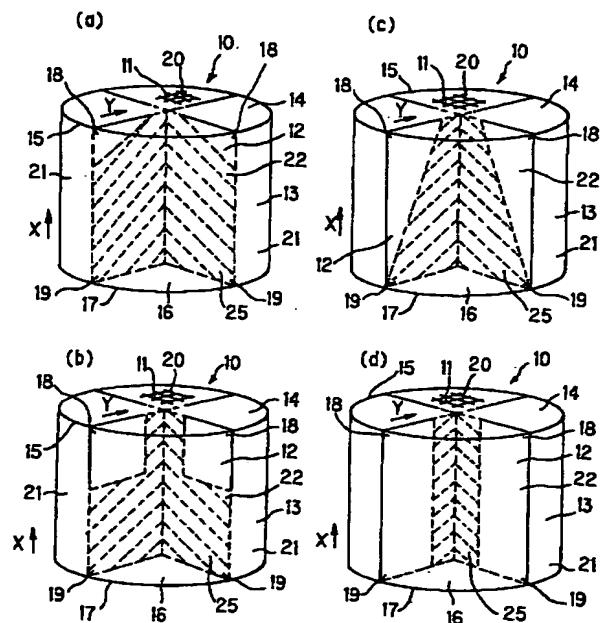
【図10】 本発明に係るハニカムフィルターの一実施例を示しており、(a)は側面図、(b)は平面図、(c)は底面図である。

【図11】 本発明に係るハニカム構造体のスリットの配置例を示しており、(a)は平面図、(b)は正面図、(c)は側面図、(d)は底面図である。

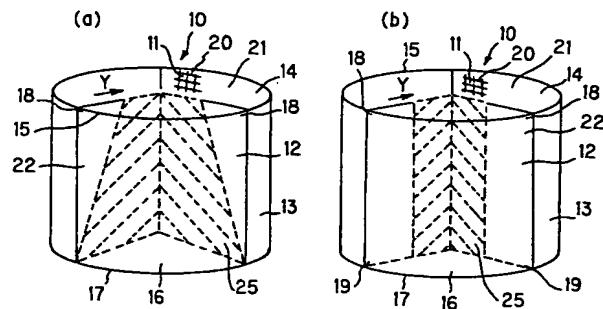
#### 【符号の説明】

1…ハニカムフィルター、10…ハニカム構造体、11…流通孔（貫通孔）、12…未接合部、13…ハニカム構造体（ハニカムフィルター）の側面、14…流路出口端面（上端面）、15…端面外周部、16…流路入口端面（下端面）、17…端面外周部、18…流路入口端面外周部に接続する端部、19…流路入口端面外周部に接続する端部、20…隔壁、21…ハニカム部材、22…接合面、24…充填部材、25…接合部材、31…未充填部、32…目封じ部材、33…ハニカムフィルター部材。

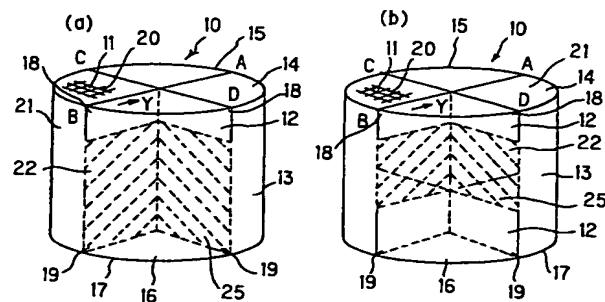
【図1】



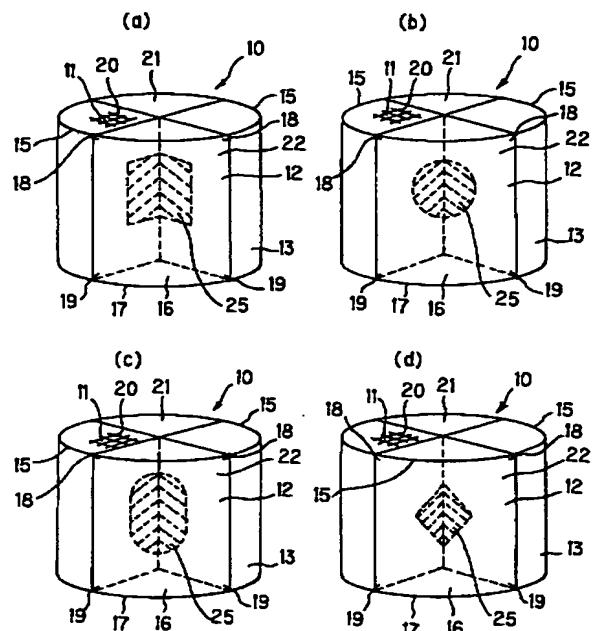
【図2】



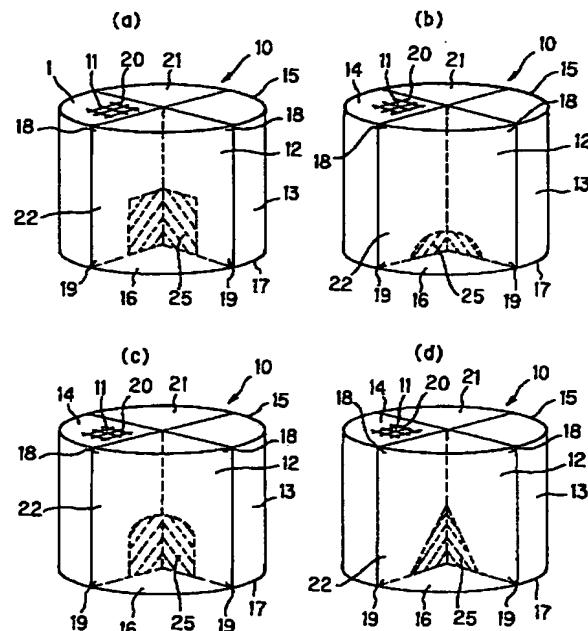
【図3】



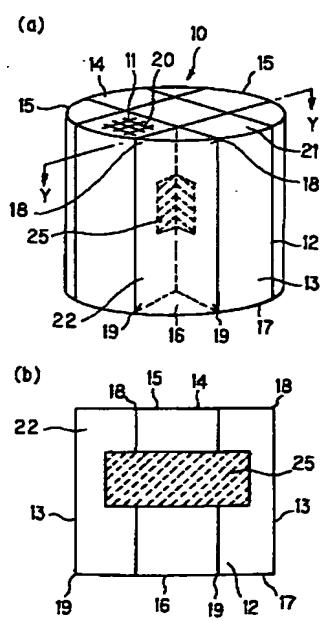
【図4】



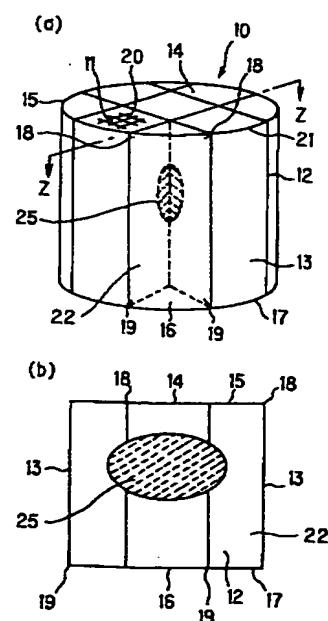
【図5】



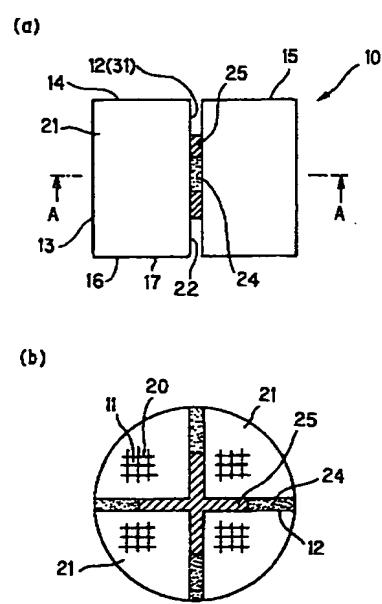
【図6】



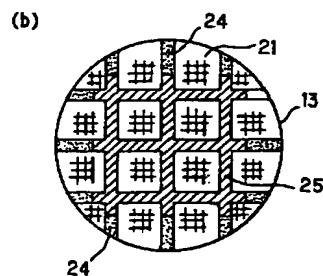
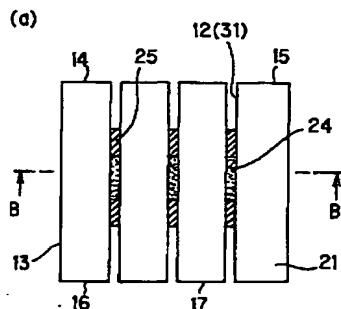
【図7】



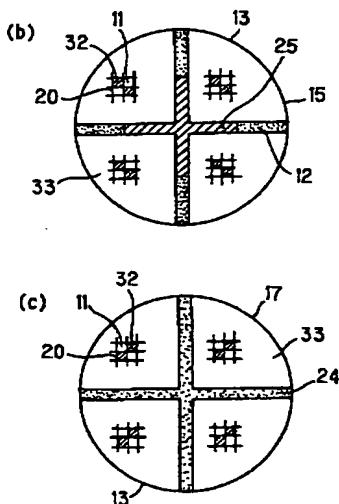
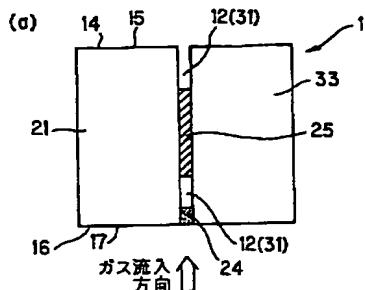
【図8】



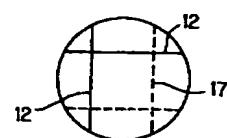
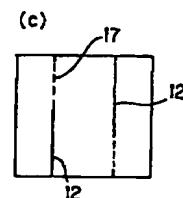
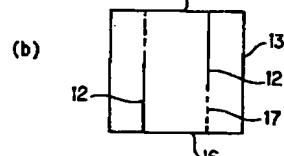
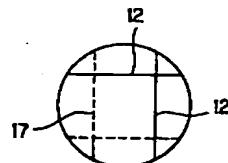
【図9】



【図10】



【図11】



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